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Assessing Sustainability: Spatial Considerations When Developing Wind Power

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Abstract:
The global goal is to have a development process that is sustainable. This can be justified for environmental, moral, and for the purpose of this study, business reasons. To do this the current business process in question, the wind project development process, should be given recommendations for sustainability. Sustainability though is dependent on the level of analysis. To benefit from sustainability thinking the level at which the wind projects impacts occur must be considered. This is why wind power is perceived sustainable at a national and global level but not at the local level where projects meet permitting resistance. By comparing the differences between sustainability at the local and national / global levels sustainability effects from wind power development can be identified. Local sustainability strategies can then be applied to the wind development process to identify when and where sustainability thinking will add value. For practical application qualitative case study data will be used to support the analysis. Grounding the analysis is an understanding of the concepts involved with framing, managing, and assessing sustainability.

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1 STUDY OVERVIEW

1.1 Introduction

"To meet the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). It seems like no paper can be written today on the topic of sustainable development without referring to the famous political definition that formally coined an idea that humanity has been wrestling with ever since humans first felt the repercussions of their actions from nature. Steps are needed in order to do move from a philosophical definition that is open to interpretation, to one that can be applied to everyday life and put into operation so that the progress that is needed can be measured.

Spatial scales must first be defined when working towards an operational definition of sustainable development. For example, global environmental benefits in the form of CO_2 reductions from renewable energy sources like wind power generated electricity are well known (IEA 2009). From this, macro level policy evaluations are commonly performed to show that renewable energy development can stimulate socioeconomic development, usually in the form of new jobs (Kammen et al. 2004). The problem is, benefits like this are often measured on the policy or national scale and the costs come at the expense of the local or project level. This macro level approach fails to account for pitfalls in the development and implementation processes with relation to how these policy goals are going to be achieved (Söderholm et al. 2007). A closer look at the local implications of policy is needed to coincide with the vision of a sustainable development.

Both human / ecological interactions and community decisions have the greatest effect at the local level (Graymore et al. 2008). At the United Nations Conference on Environment and Development (UNCD) in Rio de Janeiro global leaders produced justification for action on the local level creating Local Agenda 21. Chapter 28 states:

> "Because so many of the problems and solutions being addressed by Agenda 21 have their roots in local activities, the participation and cooperation of local authorities will be a determining factor in fulfilling its objectives. Local authorities construct, operate and maintain economic, social and environmental infrastructure, oversee planning processes, establish local environmental policies and regulations, and assist in implementing national and subnational environmental policies. As the level of governance closest to the people, they play a vital role in educating, mobilizing and responding to the public to promote sustainable development." (UNCED 1993)

Locality can consist of two distinct notions; physical and social (Selman 1996). The physical portion includes population and geographical boundaries. Effects within the physical boundaries of a locality are useful when measuring environmental impacts, material flows, or setting indicators for sustainability. The social definition relates to the locality as connections

between people who share commonalities like culture, experiences, and responsibilities. So when a social locality is affected by project development procedural concepts like participation, power perceptions, and access to information need to be considered. Acknowledgement of these two areas of locality can be avenues opening up the possibilities for community twofold. First, it is an operational definition of the shift towards local sustainability at the municipal level. Second it can be seen as way to create opportunities for project developers. If developers are able to properly account for project impacts, new business strategies may emerge as a result of increased information about a community's perception of the project impacts.

Opportunities for business

A popular way to address the question of sustainable development in business is as a related approach, for example Corporate Social Responsibility (CSR) (Garriga & Melé 2004). Reviewing popular theories on how corporations implement policies of corporate social responsibility Willard (2005) finds that CSR implementation can range from *separative* strategies such as compliance; covering legal, health and safety liabilities, to actions like philanthropy and public relations that are ultimately accounted for as a cost of business. At the other end of the spectrum *integrated* approaches encourage companies to ingrain principles of sustainability within all divisions of their business. Strategy integration of sustainability principles allows the business to move from CSR as a form of public relations to CSR as a tool to uncover competitive advantage and enhance corporate governance (Elkington 1994). Full strategic integration leads to companies assessing down to the project level to discover long term systemic impacts, which then present new business opportunities and generate value.

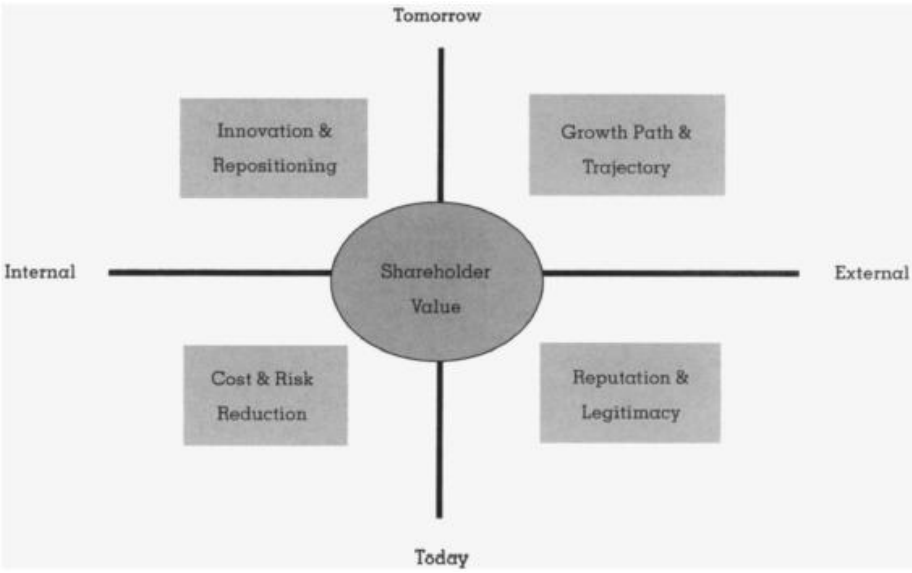

Fig. 1 Representation of key dimensions of Shareholder value (Hart et al. 2003)

When looking at a company and their choice of investments (Hart et al. 2003) finds that shareholder value is a multidimensional construct. To elaborate on Fig. 1 there are constraints on the firm along both axis's that effect share holder value creation which when combined with sustainability strategies can be strategic value. Vertically, sustainability considerations are needed to aid business planning towards balancing short term gains while continuing to innovate and grow for the future. At the same time along the horizontal axis pressures are created to incorporate outside perceptions and stakeholders with critical internal measures need to be given due attention. The potential for sustainability thinking to create sustainable value is great and underexploited (ibid).

1.2 Purpose

This study focuses on the interactions between the experiences with local sustainability assessment and how it relates to identifying opportunities for innovative avenues for value creation by integrated sustainability consideration. Realization that we have to live within planetary boundaries leads us to believe that choosing to develop in a sustainable fashion is in our long-term best interests. This has led to an increase in the development of renewable energy sources; one of the more important of these is wind power generated electricity. During this development in the name of sustainability, procedures have been missing that enable project developers to take advantage of the benefits from strategies derived from sustainability thinking. The purpose of this study is to identify the components needed to assess sustainability and then relate them:

1. to the current efforts to develop local sustainability
2. to the current wind development process to identify where they can be implemented in an overreaching business strategy
3. to analyze possible conflicts or overlapping interest between the two.

From this the following research questions are generated:

Research questions

1. There is *strategic value* in planning from a sustainability perspective, how can it be identified in the wind power development process?
2. How can this value be *integrated* in the current wind power development process?
3. How do sustainability aspects relate to the *local* level (municipality sustainability) and *national* and *international* levels (national / global sustainability)?

Scope and limitations

This study examines concepts concerning sustainable development assessment used to examine the relationship through wind power project development. It does not attempt to provide a thorough review or comparison of all methods associated with sustainability assessment, although a classification was performed to set the study in relation to the applied conceptual frameworks. Along this same line this study does not attempt to account for all of the impacts associated with wind power development. Examples will be given to prove the appropriateness of the analysis method but due to the specificity of each wind project, developers would have to identify impacts as they fit their situation. Recommendations are theoretical and so must be followed up with practical case studies to test the true usefulness of the study's outcomes. Time is always a limiting factor but the author believes that the analysis presented is sufficient for the exploratory element of a larger research design.

2 ASSESSING SUSTAINABILITY

2.1 Assessment of SD Assessments

2.1.1 *Introduction*

In order to choose an appropriate method for assessing the project impacts of wind development from a sustainability perspective an understanding of the interconnections between the "tools" and concepts that are available to frame, measure, and manage how assessments are made is reviewed. This aids in taking the debate from the theoretical to the required and measureable operational definition of sustainable development. Pezzoli (1997) findings in Table 1 support that the crux of researching sustainable development is the wide implications resulting in a literature base that spans many disciplines and includes a myriad of concepts.

Table 1. Examples of disciplines that literature on sustainable development spans (Pezzoli 1997)

1. *Managerialism, Policy and Planning* Legal- institutional terrain and state initiatives Civil society and NGOs Urban and regional planning and development Natural resources and rural development Indicators of sustainable development 2. *Social Conditions* Population Human behavior and social learning Environmental health 3. *Environmental Law* Property and development laws Legal issues concerning environmental racism, equity and justice 4. *Environmental Sciences* 5. *Eco-design and the Built Environment* 6. *Ecological Economics* Environmental and resource economics Eco-tourism Industrial Ecology	7. *Ecophilosophy ,Environmental Values and Ethics* Epistemology, science, culture and language Philosophy, policy and development Environmental justice and racism Ecofeminism 8. *Environmenta l History and Human Geography/Ecology* 9. *Utopianism,Anarchism and Bioregionalism* 10. *Political Ecology* Globalization and eco-politics Urban and regional development Rural studies Critical social movements and empowerments Theory building and agendas for research and action

This section will focus on providing a background of concepts related to the business implementation, project, plan and program, and policy levels. This categorization has been performed earlier with differences in concepts used, structure, and conclusions (Finnveden & Moberg, 2005; Hacking & Guthrie, 2007; Ness et al., 2007; Pope et al., 2004; Robèrt, 2000; Wisberg & Udo de Haus, 2002). For a better understanding of sustainable development it will be looked at in its context as a moving target and not a desired end state (Hjorth & Bagheri 2006). A systematic frame adapted from (Robèrt et al. 2002) will be used and elaborated on to present the different examples associated with assessing sustainability.

2.1.2 ***Systems thinking***

Systems thinking is a crucial step in the ongoing evaluation on how we interpret the world. Paradigm shifts have occurred from Descartes's mechanistic interpretation and reductionism in the 17th century to simple linear causation thinking and finally now to top down holistic approaches. The greatest misinterpretation of how natural systems react to our intervention is that they are predictable and function in a linear fashion (Folke et al. 2002).

Systems thinking is reinforced today by a holistic global systems perspective in the identification and quantification of the earth's systems thresholds and planetary boundaries (Rockstrom et al. 2009). Spatial characteristics can be shown even down to microorganisms' degradation of rock and their influence in supporting a self regulating micro climate which then strengthens Lovelock (2009)'s gaia theory. It is from this rational that we should base these same systemic considerations when conducting specific project impact assessments. The consideration for different systems levels is import when addressing global, national, and local sustainability because it sets the boundaries and describes the specific system of study. Thinking in terms of systems is essential to unraveling the complexity that accompanies questions of sustainability (Meadows 2008). Un-sustainability is often a failure to recognize the municipal level. This is apparent when national energy targets are set without consideration for how the power stations will affect hosting communities.

2.1.3 *Society and ecosystems*

The interconnection between the ecosphere and society is the main reason for considering how and why we must develop in a more sustainable manner. The amount of research that has been done on the interaction between society and the natural environment is extensive (Gladwin et al. 1995)(Holmberg & Robèrt 2000) and the systems dynamics between them is complex (Tikunov & Trofimov 1995). That is why it is appropriate to begin with a depiction of the ecosphere as an overarching system. The ecosphere operates between the lithosphere and the end of the atmosphere. Sustainability at this level is defined and governed by natural laws like the first and second law of thermodynamics, and the natural bio-chemical, geo-chemical, hydro, carbon, phosphorus, and nitrogen cycles. Within the ecosphere there are sub-systemic interactions between our natural eco and societal systems. The economic system distributes resources to maximize wellbeing within our societal system. With the presence of externalities social and environmental factors are not justly accounted for in traditional economic theory (Costanza & Daly 1987). These dynamic interactions between society and ecosystems call for a collaborative analysis of sustainability between natural and social sciences (Kates et al. 2001). A science for sustainability includes an integrated approach between the sciences but to acknowledge the complexity of problems associated with sustainability we must often break the boundaries of traditional academic disciplines. Problems that occur in complex systems cannot be fully comprehended without the use of experiences and methodologies to account for the drawbacks with specialization (Nissani 1997).

2.1.4 *Moving from the definition debate*

A definition should reflect the desired *state* of sustainability required for the future (Robèrt et al. 2002). There are many different interpretations when it comes to defining sustainable development. Implications that come with setting a concrete definition welcome political and ethical debates (Sachs 1999). It is because of these debates that researches commonly apply the definition provided by the World Commission on Environment and Development

(WCED) or the Bruntland report, Our Common Future "to meet the needs of the present without compromising the ability of future generations to meet their own needs." (1987) (Sabau, 2010; Robèrt, 2000; Pope et al., 2004; Tanguay et al., 2010; McDonach & Yaneske, 2002; Gladwin et al., 1995). An operational definition is crucial to taking sustainable development from this rhetoric based definition to practical guidelines. Kidd (1992) states that this does not necessarily mean though that there should be one definition that is more logical than others as long as its assumptions are outlined.

2.2 Frameworks

2.2.1 *Introduction*

What is a framework? A framework is a way to structure the systems that are being worked with relevant for studying sustainability. The most common are the three classical so called dimensions or aspects, the social, environmental, and economical. They are too general to be frames but very often used as such never the less. Frameworks should be constructed on solid ground rules for sustainability. In dealing with complex systems first order principles describing the system are needed to help guide decision making, developing monitoring indicators, and as a base to evaluate project trade offs (Holmberg & Robèrt 2000). These basic laws or assumptions help shape what is and is not included when operationally defining sustainability.

2.2.2 *Triple Bottom Line (TBL)*

Triple bottom line is a business related frame work and was first coined by John Elkington as a way for a firm to account for the value added or destroyed not only financially but from an environmental and social perspective (Elkington 1994). Because of the utility of the base idea of the framework it has been applied as a common term when referring to the three dimensions of sustainability (Hacking & Guthrie 2007) (Henriques & J. Richardson 2004). Elkington in his original definition bases the three pronged concept on seven "revolutions" and how they reflect the transition from business as usual to one that addresses sustainability concerns. Each revolution in associated with a paradigm shift in normative business. For example, businesses will be driven from simple compliance based decisions like the fore mentioned *separative* approach to those of integrated that take the initiative resulting from increased market competition. The framework can also be implemented on a sub level in the form of a measureable reporting tool.

The Compass Index of Sustainability is a product of Atkisson inc. The four directions starting from the north, stand for: Nature, Economy, Society and Wellbeing. The tool draws its strengths from its simple and understandable presentation. The directions are made up of indicators that are chosen in a public participation process and then color coded to indicate sustainability condition. The results of the aggregated index are arranged in a visually

appealing compass format and used to present an overall measurement of sustainability. (Atkisson & Lee Hatcher 2001)

The Global Reporting Initiative is another reporting framework for reporting organizational sustainability in terms of economic environmental and social performance. The reporting framework sets guidelines on how and what to report on to strive for continuity in triple bottom line reporting. One of the aims of GRI reporting is to provide credibility for nonfinancial reporting (GRI 2010).

2.2.3 *The Natural Step (TNS)*

The Natural Step theory comes from the founder of the international non-profit NGO The Natural Step and Swedish scientist Karl-Henrik Robèrt. The framework can be applied by a wide range of users for strategic planning and evaluation of activities towards sustainable outcomes. Overall, it is a systems based approach set by four basic principles to assist with the problems of systems complexity and impacts from products and processes. The framework is not considered a standalone solution but rather a mental model to facilitate dialog, help with strategic planning, and set guiding principles for the incorporation of other sustainability management, metrics, and tools (Robèrt et al. 2002). This framework will be explained in further detail later in this study.

2.2.4 *Natural Capitalism (NC)*

Natural capitalism is a framework for a new economy that departs from traditional capitalism by redefining valuing various forms of capital (L. H. Lovins & A. Lovins 2001). These forms of capital include human, financial, manufactured, and natural. The framework takes decisions and bases them on fully accounting for their impacts on natural capital but in a profitable manner. Kuo & Hsiao (2008) state that there are four main principles that aid in this transition a more comprehensive capital decision. The first principle aims to increase given resource productivity. Once this is done reducing waste and residuals by mimicking systems already present in nature is required. Products are then substituted for service flows reducing the impacts on the environment and stimulating growth in other areas of society. The final step is to take the “profits” made from the previous principles and reinvest them in natural capital. This expands the opportunity to continue growth and further protect the natural capital that the entire system is built on (L. H. Lovins & A. Lovins 2001). The number of different capital stocks can also be expand upon to include a separate social capital (Porrit 2003) or argued as an ecological economic concept in which each capital stock should be managed so that the total natural capital stock stay at or above the current level (Costanza & Daly 1992).

2.2.5 *Resource Flows (RFF)*

The Resources flows framework was created in order to track the limited resources available to a city. The specific flows categories are a product of a project through the Baltic University Urban Forum (BUUF) in which 20 cities and 15 different universities were involved. From 10

areas identified as important to for local sustainability 4 topic categories were agreed upon. These are Urban Flows; energy, water, and waste measured in kilos or kilowatts, Urban Planning; traffic, and the built environment measured in square meters, Urban Development; socio-economic development and education or the human resources, and lastly Integration; which is the efforts to create a sustainable community (Rydén 2006). These system flows are non-interchangeable much in the same way that you need a pilot, airplane and nice weather in order to travel by air. Therefore actions for these flows require integrated technical and management techniques that should stem from systems level strategies. The UN habitat agenda presents another example of a resource based frame that goes into further categorical division.

Table 2. Frameworks summary

Purpose	**Frame**	**Strength**
Reporting	TBL	Internal measures
Reporting	Compass	Easy to communicate
Reporting	GRI	Global standardization
Impacts	NSF	Connection to scientific principles
Stock mgmt	Natural Capital	Business oriented
Stock mgmt	Porrit's NC	Social included
Stock mgmt	Costanza Daly	Economic logic
Flows mgmt	Resource flows	Municipal application
Flows Mgmt	Habitat Agenda	Details social dimension

Table 2 presents a summary of the frameworks and what makes them unique. This will be helpful when choosing a framework to guide the way sustainability is assessed.

2.3 Indices, indicators, and other metrics

2.3.1 *Introduction*

An index is a quantitative or semi-quantitative measure relevant to the degree of sustainability of a system. There are thousands of different indices. Each one is derived from a set of indicators depending on the purpose of the phenomenon that needs to be measured. The indicators dictate the types of data sets that will need to be gathered. Indices range from those that compare country wide development like down to those that measure resource pathways

for planning or for a specific product or processes. They can be defined temporally as measuring past development (*ex-post*) or as a path for the future (*ex-ante*) (Ness et al. 2007).

2.3.2 *Indicators*

If "indicators are simplifications of complex phenomena," (Maclaren 1996) then it is critical that the indicators that are chosen fully represent the phenomena in question. Using crawfish deaths as an indicator to signal the presence of toxins can be useful to indicate poor water quality. Parris & Kates (2003) find that there are more than 500 different associated with measuring sustainable development. This number is well in the thousands considering fields like economics and health that organize data sets to receive the status of a system. According to Bossel (1999) indicators for sustainability can be divided into two types. The first type gives a picture of how the current situation or the viability of the current system. The second reports on the progression to a specific goal, like one dictated from a framework or its contribution to the performance of another system. Identifying and tracking key components that describe a complex system is difficult and requires sound scientific justification. This problem can be multiplied when policy makers prefer aggregated or composite indices that are easily communicated to the public. Böhringer & Jochem (2007) find that rules for the aggregation of indicators into composite indices are usually not followed with respect to most indicators used in policy practice. So it is not surprising if unsupported indicators result in misleading information.

2.3.3 *Material style indices - Material Flows (MF) (kg)*

MF is a proxy of environmental impacts where the material, energy, area, and transport are converted into a total of material flows measured in kg. Boundaries are defined between the natural sphere and the manmade or technical sphere. The inputs from the natural sphere are divided into three sources; the natural biologic, the agricultural, and the geological. Continuing through the life cycle the output section or "sink" is made up of the flows leaving the man made sphere that have no economic interest. Material Flows Analysis is a useful tool in tracking the metabolism on a regional and city scale (Barles 2009). The Material Input Per unit Service (MIPS) is a measurement tool used to track these flows. MIPS serve the same purpose as similar tools like Life Cycle Assessment but focus on material inputs and equates the flows to a utility unit of service. The final calculation shows all the flows associated with the service which reveals the true stream of resources involved with delivering the product or service. MIPS analysis is a strong step towards using dematerialization and reducing flows as a guiding management tool towards sustainability (Hinterberger et al. 1997).

2.3.4 *Ecological style indices- Ecological Footprint (FP) (ha)*

The FP is a biophysical proxy of environmental impacts where everything is converted into the standard metric of global hectars. It departs from traditional economic analysis by basing calculations on material flow analysis and the recognizing regional carrying capacities (Rees 1992). The assessment begins by tracking resources and then associating the biologically

productive area in hectars that is needed to support them. The same is true for waste generated and the area that is required for absorption. An advantage of FP is that communication to the public and policy makers about development is straight forward and clear compared with other spatial indicators (Mofatt 2000). The assessment can vary in scale from the land requirement for individual resources used in products to aggregated projection for global consumption.

2.3.5 *Social style indices*

The Human Development Index was developed by the United Nations Development Program (UNDP) and is used as a country based ranking measuring a development in three components indicators; a long and happy life, access to knowledge, and standard of living (UNDP 2009). The HDI was created to address the inherent problems with using Gross Domestic Product (GDP) as a measurement of wellbeing. Indices like these are useful in measuring and comparing information at the global and national level.

Table 3. Indicator summary

Purpose	**Indicator**	**Measures in**	**Strength**
Information	General	Figures	Customizable
Flows	MIPS	Kg	Focused on inputs
Flows	LCA	Kg	Focused on inputs and outputs
Land use	EF	ha	Shows area of land needed to support activity
Wellbeing	HDI	Figures	Country comparable
Wellbeing	GDP	Figures	Standard

Table 3 presents a summary of indicators discussed so that their function and strengths can be compared.

3 HOW TO CARRY OUT THE ASSESSMENT

3.1 Assessments

3.1.1 *Introduction*

An assessment can be performed in different ways but several procedures have to be structured in some detail to be sure to include all that is relevant. The most commonly

included factors are environmental and economic. The schemes described here are mostly limited to parts of the system and as mentioned before lack strategic oversight or integration of all aspect required for sustainability. It is here that it is most important to acknowledge the spatial differences when judging sustainability. In assessing a specific project or a specific territory sustainability can divided in substantive and procedural portions (del Río & Burguillo 2008). The substantive approach is set by the theoretical assumptions that are made regarding the choice of framework i.e. capital stocks theory of natural capitalism used to redefine the three dimensions (economic environmental, and social) of sustainable development. The second, the procedural sustainability deals with how the assessment is carried out and is often over looked (ibid).

3.1.2 *Life Cycle Assessment (LCA)*

LCA is a way of assessing the impacts that a product or service has from its conception to its end use. LCA can be useful as a multidimensional tool showing the system as a whole including an inventory of all inputs. This allows for strategically important identification of complexity. According to ISO standards the LCA process in comprised of 4 phases. The first is scoping. Scoping also includes the specification of the functional unit that describes the results of the analysis in relation the function that the process is intended for. Setting the boundaries to simplify the process in question allows for better information management but also reveals the possibility for certain inputs in the system to be left out and thus some environmental impacts are left unaccounted for (Hendrickson et al. 1998). Second is inventory where data, usually quantitative, is collected on material flows both direct and indirect, energy demands, and finally the waste streams that are generated. The inventorying is then followed by an assessment of the impacts to eventually produce an aggregated outcome. Effects from the process are categorized according to associated impact, within these categories they are separated further according to the characteristics of their contribution. After this the impacts are assigned value. With the impacts assessed the final step in the LCA process is improvement assessment, which prioritizes where the most effective areas for reducing environmental burden are identified.

LCA can be used for multiple purposes. Critical points or “hot spots,” can be identified where intervention may have the most impact along the process or within a product’s life cycle (Thomassen et al. 2008). Material flows in an LCA may also be mapped to track the utility of each unit used in production. When the entire life cycle is accounted for the results can be aggregated into one figure allowing for the comparison of similar products with the same function. Scenario analysis can also be performed by assessing the possible cause and effect impacts of new technology innovation. Further departing from LCA as a tool of measurement there are also applications of LCA as a system (Zbicinski et al. 2006). Current LCA is confined by certain product impacts set by the region in which it operates. System wide application would look at effectiveness on an impact per function, cost, and system component basis in hopes to prioritize for optimal outcomes (ibid). LCA can also be thought

of as a base for the design model Cradle to Cradle (C2C). C2C tracks the whole life cycle of a product and suggests ways to mimic natural processes to reduce environmental impacts (MBDC 2010).

3.1.3 *Full Cost & Environmental Management Accounting (FCA) (EMA)*

FCA is based off the economic concept of opportunity costs. FCA differs from traditional opportunity cost analysis in that it incorporates as many of these costs up to the point that they stop adding value to the assessment (Carter 2009). FCA follows four steps of analysis; identification of stakeholders and relevant values generation of project alternatives, evaluation of effects of alternatives on each stakeholder; tabulation, adjustment, and reporting of results. Using FCA decision-makers are presented with a way to compare projects with consideration of the effects on multiple stakeholder groups.

EMA is the process of gathering and evaluating both financial and non-financial information in hopes of balancing economic and environmental performance. EMA is a replacement of a company's existing management accounting to show where value is being added when environmental aspects are considered. The main difference from traditional accounting lies with the inclusion of aspects that are difficult to quantify. It serves as a communication technique where the company's qualities, actions, and relationships are expressed. Lastly, it is a tool for integrating identified environmental impacts into a form that decisions makers can understand and act on. EMA coordinates and assigns costs to material flows and is useful in managing different capital stocks like those used in the natural capital frames. (Jasch 2003).

3.1.4 *Environmental Impact Assessment (EIA)*

EIA is a relatively well established process used to forecast the potential impacts that a specific project will have on its surroundings. It was originally formulated in the United States and is required by law for most major projects. EIAs have been accepted as the preferred form of impact analysis as they are widely implemented internationally by both government and international agencies (Wathern 2001). The process differs from country to country but a ground frame usually consists of a series of 8 steps. First screening is done to see if an EIA is appropriate, this is followed by a scoping hearing to allow the public to weigh in with concerns. Alternatives for the proposal are discussed before an impact analysis is performed by specialist. From impact mitigation, strategies are discussed and evaluated. Finally a document is produced in the form of an Environmental Impacts Statement (EIS). The EIS is reviewed, a decision is made on the project, and the whole system is concluded with a scheduled follow-up plan.

3.1.5 *Environmental Impact Assessment (SEA)*

SEA is a way to account for the impacts that certain planning, policies, or programs have on the surrounding environment. It is similar to project specific EIA but is implemented at the beginning of a planning process and includes a wider scope. With this, a SEA can

systematically integrate principles of sustainable development better than the traditional EIA by giving a more fair assessment of the environmental impact because they include stakeholder input during the beginning phase and are not prepared by project developers (Shepherd & Ortolano 1996). That said, the EIA is still an important part of the SEA because of its proven track record (OECD 2006).

3.1.6 *Social Impact Assessment (SIA)*

SIA estimates in advance the social consequences resulting from policy or project development. Typical social consequences measured include cultural changes that alter the way people; work, play, relate to one another, organize their needs, or cope with other members of society (Vanclay 2003). When assessing policy or project impacts SIA has traditionally been implemented on a national policy framework scale. However SIA can also be a useful tool in the planning stage of projects giving insight into the effect the process of social change such as changes affecting norms, values beliefs, and a person's sense of place in society (ibid). From a value standpoint SIA is helpful in minimizing local resistance to projects that could result in additional time and added costs (Burdge & Vanclay 1996).

3.1.7 *Integrated Assessment*

Integrated assessment (IA) combines various tools in order to explore the effects of a particular policy or project. The most common assessment techniques are analytical by nature and often require cooperation between users from various disciplines where they are commonly applied (Rotmans & van Asselt 2001). For project specific or regional policy assessment Cost Benefit Analysis, Multi-Criteria Analysis, and Risk Assessment are common economic based assessments. There is a risk that true integration is substituted by methodological expansion of the assessment technique which can be attributed to disciplinary protectionism (Scrase & Sheate 2002).

Table 4 Assessments summary

Level	Approach	Tool	Application
System overview	Component ID	LCA	Assessment
	Component ID.	C2C	Assessment
System impacts	Impact ID	LCA	Assessment
	Materials impacts	C2C	Assessment
	Econ Accounting	FCA & EMA	Accounting
	Environmental	EIA	Assessment
	Strategic	SEA	Strategic Assessment
	Social	SIA	Assessment
	Multiple tool integration	IA	Strategic Assessment
System dynamics	Diff equations	LCA	Scenario Assessment

Table 4 presents a summary of the assessment related approaches discussed. Their application is classified according to the systemic level that they are useful for.

4 MANAGEMENT SYSTEMS

4.1 Introduction

Management systems are needed to carry out and implement decisions. The management cycle is based off the famous business based Shewhart/Deming Plan Do Check Act method. Environmental management systems are meant to solve the problems between higher level strategic planning and those that practitioners face during implementation and maintenance of the system. Management systems ensure that the process does not end with the assessment phase.

4.2 ISO 14000

ISO 14001 certification is used as part of an environmental management program to manage individual organization's impact on the environment. Developed by the International Standards Organization it is designed to set requirements for individual organizations to meet their predetermined environmental objectives and policies with relation to their product's characteristics and the environment in which they operate (ISO 2010). Attaining the ISO

14001 certificate is a method to translate the top tier systematic principles associated with sustainable development, down to an operational local or subsystem level. It is in this area that ISO 14001 appeals to individual organizations such as private firms, local governments, and universities. Potential areas of conflict arise when the guiding standards are set to how the finished process is audited. ISO 14001 functions in a set cycle starting with a review of current environmental policy. Then planning is done to identify impacts they create and programs are setup to mitigate these impacts. The programs are then implemented and assigned accountability. For example, inclusion of an environmental management system like ISO 14001 can improve upon shortcomings, add measurable environmental impacts and a sustainability aspect from clear defining principles like those mentioned in TNS framework (Burns & Kranz 1997).

4.3 European Eco-Management and Audit Scheme (EMAS)

EMAS is also a management tool designed to help organizations improve their environmental performance. The term organization refers mainly to companies. EMAS differs from ISO 14001 in that it is only available to member states of the European Union and is based on European Union regulations (Bracke & Albrecht 2007). EMAS is more rigorous in requiring environmental actions after assessment, compared to the ISO 14001 it also carries legal status within the European Union (Morrow & Rondinelli 2002). The latest version incorporated ISO 14001 as an environmental management subsystem. EMAS consists of four main stages: environmental review, environmental management system, environmental audit, and a statement of performance. These are broken down into three quantifiable areas operational, management, and environmental condition performance indicators (EUC 2003).Seen from these stages EMAS not only requires environmental management because later the entire scheme is then measured on a performance basis.

4.4 Sustainability Balanced Scorecard (SBSC)

Based on the popular management tool by Kaplan and Norton SBSC can be seen as one step further in associating non financial asset's contribution with the long-term strategic growth of a company. It is especially helpful in turning strategy into operational action. The score card is used to relate overall company strategy to four dimensions; financial, customer, internal business processes, organizational learning, and growth. The strategy mapping used in SBSC shows systemic relations among the four dimensions that are most interesting in terms of sustainability. It is here that the company can see interdependencies and associate the non-financial benefits with added value. The inclusion of new indicators of sustainability that restructure the strategy map is another difference from the standard score card (Möller & Schaltegger 2005). Including non-market perspectives without a relation to financial terms is another unique way that SCSB connects sustainability a business's strategy based long term growth goals (Figge et al. 2002).

Table 5. Management systems summary

System	Regulation	Strength
ISO 14000	External	International standard, measured on constant progress only
EMAS	External	Legally binding, reporting data easier , comparable within EU
SBSC	Internal	Integrates companywide sustainability efforts into overall vision

Table 5 summarizes the relationships that different options for the management of sustainability programs.

5 CASE STUDIES

5.1 Cases

To collect qualitative empirical data the case study methodology was chosen. Practical grounds for this decision were based on what Myers (2009) refers to as the ability to use empirical evidence from real people in real life situations. Yin (2003) describes this situation as appropriate when the boundaries between the phenomena and the context are cannot be clearly defined. This idea of a blurred boarder between context and phenomena was another reason behind taking an exploratory research design approach. The case study approach is also justifiable by the difficulty in manipulating dependent and independent variables and revealing all the hidden variables that are in play when collecting relevant data (Yin 2003). Two Swedish cases were examined on account of their uniqueness, Tanum municipality and the Huds Moar wind park with its culturally rich surroundings and Piteå municipality and the Bondön wind park with its unique development strategy.

5.2 Method

Semi-structured group interviews were conducted combined with a participatory diagramming structure. The process was carried out according to the participatory approach stated in Pretty et al. (1995). This approach was chosen because of principle links to procedural sustainability. These links include; the focused learning of all participants, multiple perspectives to seek diversity of opinion, context specific greater sense of ownership, facilitating experts to improve situations and stake holders, and path for change (ibid). The research method also coincided with the development theme of the study. Instead of coming in as an outsider and extracting information, a search was done for a method that enables a sharing of knowledge and experience from the local actors was preferred. The fact that this method can be used for interviewees to analyze their own conditions is also a positive if research is assumed to inspire

action. Documents were reviewed during and after the interviews to give responses context and to ensure quality by triangulated data collected.

Municipality personnel were chosen as respondents for the interviews because of crucial role that the local municipality plays in the permitting process. The interview participants were selected by making contact with the municipality and requesting a meeting with the group of employees most involved with the past and present permitting of land based wind power. A larger focus group would have been preferred but in both cases there were only three that are extensively involved with the permitting process.

Table 6. Key municipality personnel and their positions from Piteå

Town	**Respondent**	**Position**
Piteå	Florian Steiner	Town Planner
	Tomas Oman	Environmental Protection
	Per Lidström	Former Director of Building & Environment
Tanum	Robert Engblom	Planning Architect
	Ingvar Olofsson	Environmental Protection Officer
	Rolf Hermansson	Politician, Chairman Environ. & Building committee

The respondents identified in Table 6 were presented a statement of purpose for the study and a schedule for the interview process (Appendix 1). They then answered questions lead by a structured interview guide (Appendix 2) that followed the permitting process system in a diagram. The diagram was discussed throughout the interview to insure that it clearly represented the responses from the respondents. This process aided in the analysis of the interview data as key groups of data were already categorized and linked to actors, causes and effects. The entire diagram was then photographed and the individual sections of the diagram where saved for later review. At the end of each interview results were discussed and both parties acknowledged how the process was helpful.

5.3 **Analysis**

Data gathered from the interviews was combined with a review of documentation and conclusions from pertinent literature on wind power development and sustainability. The five level model the Framework for Strategic Sustainable Development (FSSD) presented by (Robèrt 2000) was used to guide the strategic evaluation. The TNS theory was used to

exemplify the wind development process in a global and national sustainability context while the Resource Flows Framework was used to depict that of the municipalities.

Classifying the data in this fashion sets the results of the case studies within their context. The method of analysis aids in making the results as practical as possible. It achieves this by strengthening the connections between concepts and their areas of application. Because of the participatory diagramming process the data from the interviews was already grouped in categories structured by the interview guide. The categories where crosschecked between the two case studies to provide a standard category form to draw conclusions for the two cases.

The purpose of the study as it relates to a wider research design is exploratory. This means that use of the conceptual framework is meant to discover and elaborate on interesting factors around sustainability and the process of permitting wind power. To generate knowledge this study uses an interpretive epistemology. First is because of the difficulty in separating the phenomenon wind farm development permitting from the context of the host municipality. Second is because the bulk of empirical information gathered is from the experiences of municipal employees involved with the planning process of the wind parks. The context of their experience greatly affects the data outcome. Interpretive epistemology also coincides with the study's aim to look for the general way that thinking in terms of how sustainability can add value to the wind development process. Through contextual observations patterns will be noted interpreted and analyzed to come to the study's conclusion.

For questions of validity the conclusions of the study should be judged by the plausibility and strength of the proposed argument/analysis as it will not be easily replicable. Reliability will also be difficult because of the specific interpretive qualitative context of the study. Dependability will be the quality check for this study by presenting a clear and straight forward research methodology. Generalizability will be substituted for transferability based on comparison (Finfgeld-Connett 2010). The qualitative findings of the study will not be able to be statistically generalizable so they must be weighted on the specific instances that users of the finding wish to transfer to like situations. These distinctions are common with non sampling qualitative data collection and to combat this downside a straight forward methodology and source triangulation is applied (Sekaran 1992).

From the hypothetico/deductive method, observation and preliminary information gathering started the process for this specific topic of study. From past experience within wind project development gaps were noticed between the wind development process and interactions in hosting communities. This observation was strengthen by a search for phenomena that would benefit from sustainability theory during a six month long internship within the sales, service and maintenance, and project development divisions of Nordex, a major wind turbine manufacturer. Project development was confirmed as the most suitable division where the firm could benefit sustainability theory. Information was gathered informally through

unstructured interviews with practitioners varying in seniority and areas of specialty within the project development division.

6 CASE RESULTS

This chapter will present a general overview of the findings from the two cases: Piteå municipality, Bondön wind park and Tanum municipality, Huds Moar wind park. This is preceded by a short introduction to the Swedish permitting process. The interview information was abridged and categorized into relevant headings. Specific examples from the interviews will be used to support the analysis section.

6.1 The Swedish wind power permitting procedure

The hierarchy of the Swedish wind power permitting works as follows. The Swedish parliament creates Environmental Codes to dictate the use and set requirements for actions concerning impacts on natural resources (SFS 1998). This law is then clarified and set by Swedish government which categorizes the nature of the activity into three classes ABC descending in order from greatest impact. If an activity is authorized by the government under the Environmental Code a permit anywhere else is not needed.

Most commercial wind power falls under the B category which defers the permit issuing to the county level. The county assesses the project and can then issue the permit if it deems so holding that the local municipality has no objections.

Under this the local municipality where the project is a concern has, under the Planning and Building Act (Plan-och bygglag) (1987:10) the right to self governance regarding issues of influence and land use in the municipality. The local municipality has the right to veto any permit that is within their locality under 22. 6 § of the Environmental Code. Contrary to this, if deemed necessary the government may overrule and allow the project under 17. 6 § of the Environmental Code, this is an extreme case.

The Swedish government has identified national areas that are suitable for wind development by meso-scale wind analysis. The corresponding counties that these areas are located are responsible for the integration of these areas into their Master Plan. Issues regarding local impacts are up to the local authorities to decide. Each community has a Municipal Comprehensive Plan (MCP) (översiktsplan) which sets policy and provides guidance to questions of land use and built environment but this is not legally binding. The Detailed Development Plan (DDP) (detaljplan) is legally binding and most commonly used in municipal land use planning. It is through this process and by the power of the Planning and Building Act that it is the municipality that ultimately has the power to deny land use permits (Khan 2003).

6.2 Piteå Municipality: Bondön Wind Park

6.2.1 *Piteå-background*

The municipality of Piteå with its population of around 41,000 inhabitants has an average of 13 inhabitants / km^2 ranking 212th out of 290 municipalities in Sweden (SBC 2009a). Piteå is geographically situated in the northern tip of Sweden (see Fig. 2) around 1000 km south from the Arctic Circle at the mouth of the Pite river. Of the surrounding 3085 km^2 heavily forested area .6% is environmentally protected. Along its coast, Piteå enjoys an attractive archipelago. The second largest industrial branch behind health and care giving is heavy industry, chiefly manufacturing and extraction (SBC 2009a). Piteå traditionally has had a strong forestry industry which includes the existing saw and paper mills that can be accessed by deep water harbor and railway. It is Piteå's developmental strategy that makes it a particularly interesting case study. From its base pulp and paper industry Piteå has set out to diversify its economic base particularly within the "green" sector.

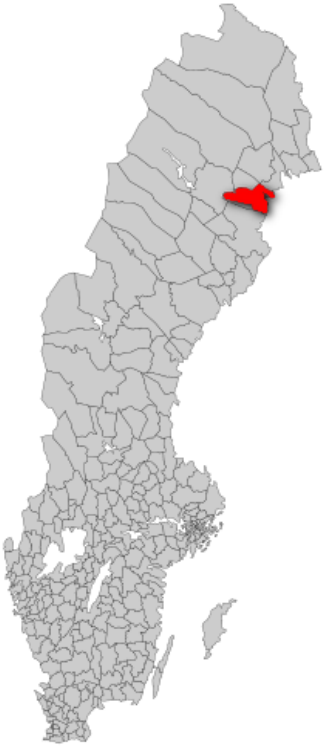

Fig. 2 Piteå municipality in relation to the county of Sweden

On a municipal level in 2007 Piteå was selected to participate in the Swedish Energy Authority's sustainable city program (Piteå 2008). Commercially it has developed three new development centers covering; music and media, business development, and science. The Science Park is currently under construction but when completed will house Piteå's long standing forest based renewable energy/technology development. Piteå's involvement in wind power is especially unique. Housed in one of its business development areas is the Wind Power Center for the Barenets Region. This center acts as a hub connecting private interests, wind power developers, and the public. The center also sets the stage for the Markbygden project with 1,100 proposed turbines delivering at its completion around 12 TWh (terawatt hours) of electricity, making it the largest wind park ever built in Sweden. The project, which would be located in an area outside of Piteå, is proposed to include the construction of a concrete factory for the towers and provide at least 110 new service jobs (Westerberg 2009).

6.2.2 *Bondön wind park*

The Bondön wind farm is erected on a peninsula 15 kilometers southeast of central Piteå. It is made up of 14 Nordex wind turbines each 2.5 MW and was commissioned in January 2009. There are no permanent residences within a 1.8 km range and all of the land that is built on is owned by a single person. Surrounding Bondön there is a series of small islands designated as nature reserves. To the North West is the harbor and if continuing in this direction the center of Piteå is reached (see Fig. 3)

Interview results

Vision

The vision behind the Bondön project came from outside private interest because initially the municipality had no energy specific sustainability plan. There were two existing wind turbines north of the project area and casual conversations with this developer where had identifying possible areas where the municipality could generate its own electrical power.

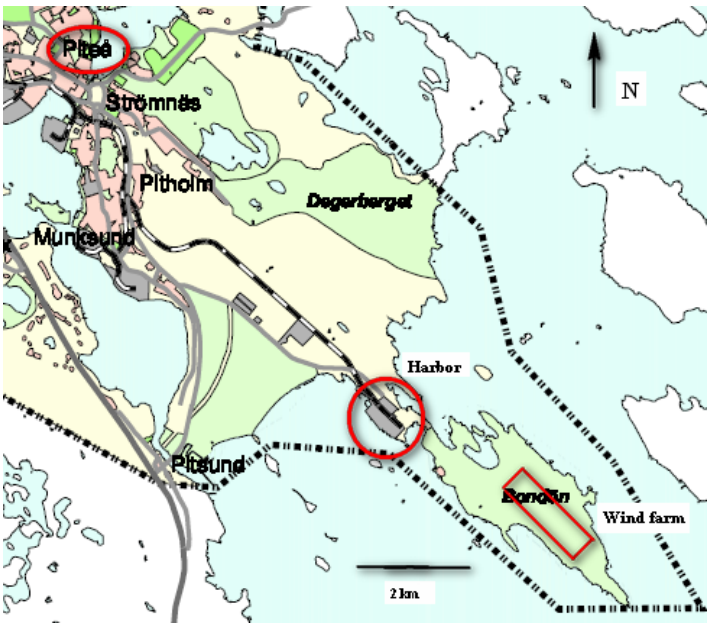

Fig.3 Detailed position of Bondön wind park

Planning specific steps

The inclusion of the Bondön wind project in the Municipal Comprehensive Plan (MCP) was faster than normal because of the MCP work that was put on hold for a neighboring resort hotel. With no objections from the municipality the planners where able to designate the Bondön area for wind development. Because the development was support by the MCP the Detailed Development Plan (DDP) process also went relatively quickly. The planners attention on these planning measures meant that an archipelago wide MCP was put on hold.

Objections during planning

During the DDP scoping sessions there were not many objections to the wind park. Summer house owners cited noise, light, and effects from the associated power lines as their main concerns. These were mitigated by burying the lines providing model simulations for visual impacts and presentation of legal noise limits from the turbines. White tailed eagles were also a concern but a nesting inventory ruled out any adverse impacts. Since then the eagle population has risen dramatically. An objection was made about the impacts on the archipelago but the group did not meet the needed requirements. After the park was successfully permitted it sat for three years from lack of a purchaser for the project. Within the last 2 years of the permit's validity a buyer was found and the park began construction.

Effects of Bondön

After Bondön there was a noticed increase in the amount of discussions centered on how more wind turbines within the municipality would affect local tourism. Dealing with issues around wind power is still relatively new for Piteå and its planers. There is more focus now on big picture questions (landscape analysis, policy for visual aspects), that was not present during 2001 when Bondön was being planned. During the archipelago wide MCP values based questions like how to account for historical fishing houses were more frequent.

"People woke up a little bit and became more active in the planning process". (Piteå Group Interview et al. 2010)

Media interest also increased, often criticizing that the municipality had given the archipelago away. The outcome was a decision that the archipelago was now off limits for wind power development.

Retro impacts of Bondön

Impacts as a result of Bondön are noted as minimal. Noise is not an issue because of the distance to residences. There were some unexpected problems. The first, lighting on top of the turbines stemming from a day and night time settings was remedied by adjustments made by Nordex. The second was electrical effects between the turbines that influenced how much power could be delivered to the grid system. This has social effects because people are given the idea that they have to live with a development that is not working properly. There are also social connotations to someone being hung when the turbines are standing still. The general impression from the planners was that the public has gotten used to and accepts the park but the rumors of a 16 turbines expansion with higher towers has people worried.

Lessons learned

The planners believe that there could have been more opportunities for participation but they, like the public, had no prior experience in these matters. That is why they welcome any

chance for more information. From the Bondön development process they have gained a lot of knowledge which is still continuing today. They stress that good developer relations are important. This is especially true with regards to the native Lapplanders who still use the Bondön area for reindeer grazing.

"People that use the resources of the region should be able to provide feedback and when they do this they should be met with respect" (Piteå Group Interview et al. 2010)

Future development

Foreign investment in wind development is a concern for the public. The sizable outside investment needed for the 1,100 turbine Markbygden project brings up the same questions that surround the export of other resources in the region.

"Northern Sweden has exported wood, water, and now wind. People are a little bitter that more of the income has not stayed in the north and wonder if they are making the same mistake a third time." (Piteå Group Interview et al. 2010)

If the public does not see any form of larger benefits on the community level they start to question why others should profit from their hunting, berry picking, and recreational areas. Jobs are seen a top benefit in this regard. The public believed that there would be more opportunities like this from Bondön. They also note that the local energy company declined to invest in Bondön. The public perception is that with the size of Markbygden this may be last time they get to address these concerns.

Local national global

The local perspective was identified as more important that national and global. The connection to national and global benefits mostly happens at the municipal level. Therefore it would be helpful in communicating this to the public when projects are proposed. It is hard for the public to consider these connections when they are the ones that receive the impacts. The pace of development resembles the development of the hydro-electric and forestry industry. This worries the public and they question the appropriateness of having wind development at the purposed scale.

"People could handle 16 turbines with, Bondön but 1,100 it harder to comprehend. Bondön was something that was new and exciting but now one is left thinking what have I gotten myself into?" (Piteå Group Interview et al. 2010)

Job creation was mentioned again as a way for people to relate development to the personal and local realm. Planners stress that the public needs these concrete examples to show what they receive in return. An example is the production of industrial components associated with wind power to encouraging similar production for renewable energy. The turbine supplier for Markbygden has proposed building a concrete factory for its towers, providing skilled jobs to

the municipality. Attracting long-term jobs was also the point with the new Wind Power Center in Piteå. This sort of development is seen as a good way to diversify the municipality's industrial makeup in lieu of recent cuts in existing factories.

Development for the future

Suggestions were given on ways to improve wind development in the future. To address compensation a reorganization of tax revenue did not seem as realistic as municipality / developer collaborations to build local infrastructure projects. Financial support for improvement projects is an option for villages within the Markbygden. The Swedish wind development company Kraftö's early invitation for direct project investment was seen as a positive way to present the possibility for the public to take ownership in local projects. Receiving information from the public was also stressed as something that will continue to be important for good relations between the public and developers.

6.3 Tanum Municipality: Huds Moar Wind Park

6.3.1 *Tanum - background*

Tanum municipality has a population around 12, 000 and roughly 13 inhabitants / km^2 ranking 211th out of the 290 municipalities in Sweden (SBC 2009). Most of Tanum's population is concentrated along the coast. Tanum is geographically located on the south west coast of Sweden (see Fig. 4) near the border to Norway. Extending down from the coast of Norway Tanum has a portion of Sweden's first oceanic nature reserve Kosterhavet. Further inland Tanum's landscape is characterized by rolling hills, forests and smooth bedrock. Historically, small fishing villages have been the mainstay for the local population but recently manufacturing and commerce / communication are the top contributors to Tanum's economy (SBC 2009). Tanum can be reached from European highway 6 as well as from one of the many small harbors within the municipality.

Fig. 4 Tanum municipality in relation to the county of Sweden

It is because of Tanum's unique cultural heritage and past experience with wind power that makes it an interesting case for this study. Tanum is home to The Rock Carvings of Tanum which are listed as an UNESCO world heritage site. Tanum has been receptive towards wind power with nine different sites equaling a total of 36 turbines within the municipality. Tanum is also one of the 31 / 290 Swedish municipalities that have successfully completed a state supported wind development planning effort to incorporate wind development areas in their MCP (Boverket 2010).

6.3.2 *Huds Moar*

The Huds Moar wind park is erected on series of small hills roughly 6 kilometers southeast of the town of Tanumshede and roughly 2 kilometers from the smaller town of Rabbalshede (see Fig. 5). The park is made up of 6 Nordex wind turbines each 2.5 MW and was commissioned July 2008. To the North of Huds Moar there is a community swimming area, to the west is the E-6 highway, and to the east is a gravel quarry. The world heritage site is roughly 3 kilometers from Huds Moar and the park is slightly visible from a photomontage depiction (Ung 2005).

Interview results

Vision

Vision for renewable energy came from outside sources. The question of renewable energy was an environmental and political one. The first wind entrepreneur recognized that development along the coast was impossible so opted for inland sites. In 1998 around the discussion of turbine placement in the municipality Tanum drafted its first MCP for wind power. This prompted many requests for inland permits by the entrepreneur. After the large state owned Swedish energy company Vattenfall came and asked for the municipality's thoughts on wind power they built some of the first wind parks in Tanum in cooperation with the entrepreneur.

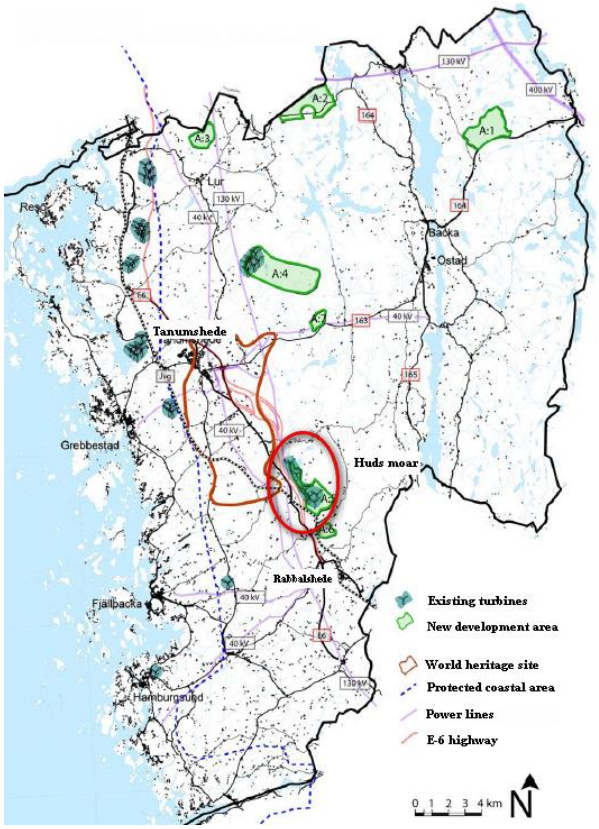

Fig.5 Detailed position of Bondön wind park

Energy discussions

Tanum has a rich experience with renewable energy ranging from hydro-electric, geothermal, to nuclear. Geothermal was found to be unfeasible at the time and hydroelectric included too many environmental complications. The public was vehemently against the proposed plans for nuclear related enrichment and storage facilities which resulted in various forms of public demonstrations. Local Agenda 21 also served as a platform to open energy discussions.

"It is not easy to talk about energy direction at a municipality level; these are difficult questions to answer at a national level." (Tanum Group Interview et al. 2010)

The municipal energy debate was supported by past experience and Agenda 21 but it was when wind power became economically viable that the process drove itself.

Planning specific steps

When the Huds Moar project came to the county planning department of the municipality it stirred more discussion on landscape values. Except for the cultural, all other divisions approved the permitting. Political discussions around landscape values started with groupings of turbines so that the turbines were not the dominant features in view. The discussion proceeded stepwise from total energy to be produced to specific wind development areas and finally exactly how many turbines in each area. The IPCC report on climate change brought another element to discussions as so did the Swedish Energy Authority recommended areas of national wind interest.

The areas of national interest put great pressure on the planners because they were in the middle of spending state money to come up with a Wind specific Municipal Comprehensive Plan (WMCP). These discussions combined with the public's views made the planners conclude that the solution would have to be a compromise between all stakeholders' interests. Past experience with wind and renewable energy gave them valuable experience when it came to addressing landscape values. Planning was done incorporating these views and identifying areas of no development. Huds Moar fit with these debates as long as it was not too close affecting the world heritage site which along with the landscape is important to the tourist industry.

Effects of Huds Moar

Wind power in general up to this point has not affected the tourism in Tanum. There have been no unexpected effects or complaints about Huds Moar. Huds Moar specifically is located in an already disturbed area with the neighboring highways and gravel quarry. The park is quiet, a turbine was moved during planning due to views from a local swimming area, and one neighbor was concerned about the effects on their horseback riding business. These impacts were addressed at a government level as oppose to public outcry. Concerns rise when

turbines are placed where there is contrasting landscape. Huds Moar is safe in this regard, it sits on top of rolling hills and forest, as oppose to drastic jagged black cliffs meeting the rolling sea bottom.

Retro impacts of wind development

The impacts of wind power in Tanum can be generalized from concerns for size, volume of applications, and economics. Due to the pace of growth in turbine heights and the amount of applications for projects Tanum realizes they must have very formal plans to avoid a landscape dominated by development. Their economic concerns stem from the new wind specific MCP and who will pay for the upgrades needed for the electricity grid.

Discussions started with their own energy production but now are more towards how much of the national goals should Tanum shoulder? Comparatively they are doing quite well with their contribution to national goals. In the future with better lines and turbines they have the possibility to contribute even more.

Lessons learned

To continuously improve their planning process they look to their past experiences. Those who are critical are so because they would have preferred more of a precautionary wait and see development to judge the impacts of their decisions. Their past experiences are also their main contribution to the Integrated Coastal Zone Management program they are a part of. Through this network of neighboring municipalities zone-wide topics like wind power development are discussed. When designing their own wind specific MCP they looked to other municipalities for experience. They opted from a thin easy to communicate plan to comprehensive plan that would specify Yes and No areas for development.

Future development

The municipalities know that they will not be able to accept all requests for permitting so it may cause strain on the community when developers talk of plans of development and compensation that may never materialize. They do not have municipal energy plans per se. Rather the decisions are influenced by their past experience, national goals, and their duty to the public. The pace of development went from a relatively nonexistent to now where it:

“Feels like all the strings are being pulled at once to catch up” (Tanum Group Interview et al. 2010)

This puts the pressure on for fast development. As development continues the question of compensation is more frequent. The municipal role is to uphold the laws in place to protect the public but it would be helpful if developers could start showing how Tanum benefits economically. Jobs and effects on local energy prices were top concerns. After the development is complete not many people know how the developments are affecting their

community. Providing this makes it easier for the public and politicians to have informed discussion around the issue and to show how future generation benefit.

Local national global

Tanum saw the local-national-global question in terms of planning. Compromise was the solution that kept the interests between the politicians, the state, and the public happy when drafting their wind specific MCP. Areas that are depicted as national interest do not fully take the local impacts like landscape values social effects into consideration. It would be difficult for a developer to have to account for municipal impacts; instead it is the financing for municipal wind planning assistance where this should be addressed. Tanum needs to consider outside perceptions of their area.

"People come to Tanum for the scenery and the nature, it would be a shame they stopped coming on account of the turbines" (Tanum Group Interview et al. 2010)

Development for the future

Tanum's municipal energy goals have been shaped by their responsibility to national goals and past experience. They are influenced by national goals, a duty to their inhabitants and the tourist industry they depend on. Tanum is still positive toward wind power but feels like they need to slow down and see the effects from the decisions they have already made. Grouping is their answer to landscape values which ensures they have:

"Wind turbines in the landscape instead of a landscape of wind turbines." (Tanum Group Interview et al. 2010)

7 ANALYSIS

The analysis section will begin with a short description of the methodological framework that will be used to relate the wind development process and supporting theories to strategic solutions towards sustainable development.

7.1 The Framework for Strategic Sustainable development (FSSD)

The strategic framework that was chosen for this study was selected based on three criteria.

1. *Established*- The framework has to already have been established and have a track record of implementation. The purpose of this study is not to construct a sustainability framework, so building off of an existing framework is necessary. The Natural Step (TNS) theory which is the basis for the Framework for Strategic Sustainable Development (FSSD) has been around since the 1980's and has academically been available for peer reviewed since 1995 (J. Holmberg 1995). In

a business sense, there is a network of international Natural Step NGOs that are presently operating in 11 different countries. These natural step foundations have worked with communities and their methodologies been applied to thousands of businesses. (The Natural Step 2010).

2. *Based on concrete systems based principles*- This study takes grounded systems theory as a base criteria for all measures of sustainability. For reason outlined in section 2.1.2 The basic principles for sustainability must have a clear connection to natural limits so measureable material flows and indicators can be calculated. A combination of these two should also allow for the inclusion of social and rights based dependency that is inherent in practice through socio-ecological systems. NFS theory satisfies the systems requirement through its cyclical principle but is highly general manner (Upham 2000). Clear connections to natural limits is satisfied by the TNS's four systems conditions that have been mentioned by the US academy of science for its ability to organizing and address information around sustainability problems (The Natural Step US 2010).

3. *Flexible & inclusion of existing tools*- Sustainability requirements cannot be applied uniformly, there are different requirements depending available resources. That is why a portion of the frame should approach sustainability from a strategic standpoint. The FSSD acknowledges the importance of using quantitative metrics but its usefulness comes from the principles that guide the selection of what to include in these metrics (Robèrt 2000). In the interest of the work carried out previously while relating existing tools to their ground functions the frame must also act as guidance and be able to include or at least relate other "tools" or concepts pertinent to sustainable development. The framework does this using an array of management, project and policy tools (Robèrt et al. 2002) as well as tools for product analysis (Byggeth & Hochschorner 2006).

FSSD Model: Strategic planning for complex systems

Complexity lies behind questions of sustainable development. Dealing with complexity is satisfied in the framework by thinking further up the causal stream to find root sources. Upstream thinking in accomplished by a strategic planning approach called backcasting. This differs from forecasting in that the desired state of the system or sustainability in general is defined and then decisions are planned in order to achieve this reality. Backcasting differs from past methods of evaluation in that these were created in the context of current unsustainable practices (Holmberg & Robèrt 2000). Backcasting thus encourages innovative, creative, and proactive solutions.

Backcasting should be accompanied by (principles, conditions, activities, and metrics) to bridge the conceptual gap between the theoretical and the practical. A five level hierarchical

model, the Framework for Strategic Sustainable Development (Table 7) can be used to guide strategic steps towards the goal of a sustainable development (Robèrt 2000) (Robèrt et al. 2005):

Table 7. Five level model for the Framework of Strategic Sustainable Development (Robèrt 2000)

Level	**Concepts**	**Related section**
1. System	Ecosphere & societal system	2.1
2. Success	Frames , TNS 4 systems conditions, RFF resource flows	2.2
3. Strategy	Principles of: Strategic investment- backcasting, flexible platforms, return on investment, precautionary principle	
4. Actions	Resource allocation to critical parts of development process	
5. Tools	LCA, EF, indicators, ISO 1400	2.3-4.4

1. *System Overview*. The systems overview is set by constitutional principles that describe the system and the interconnections and dependencies that it holds to other systems. The FSSD framework uses the metaphor of a funnel. Society as a whole is extracting resources and accumulating waste at levels violate life supporting constraints. The funnel of possibilities will continue to get smaller until sustainable solutions are found to expand the opening again.

2. *Success.* Principles that determine favorable outcomes i.e. a sustainable development are presented in Fig. 6 as the 4 systems conditions of TNS.

In a sustainable society nature's functions and diversity is not subject to systematic increases in:

Condition 1: Concentrations of substances extracted from the earth's crust ex.

Condition 2: Concentrations of substances produced by society

Condition 3: Degradation by physical means

Condition 4: Human needs are met worldwide within the frame laid by the first three system

Fig.6 The FSSD principles of sustainability

These non-overlapping principles or systems conditions set the parameters for indicators that are necessary to meet the outcome of sustainability not elongate the transition of sustainable development (Holmberg & Robèrt 2000). The first three simplify the complexity of ecological

sustainability by taking a balanced flows approach because feedback mechanisms and systemic tipping points are difficult to predict. This concludes that ecologic systems must be satisfied on the first order. The fourth condition specifies how society may allocate or turn the available resources over (ibid). Strategic planning then takes these system conditions and turns them into objectives. Objects can be further developed on different scales by applying dematerialization substitution mechanisms. Dematerialization relates to the reduction of material flows and substitution replaces the type or the quality associated with material flows (Robèrt et al. 2002).

3. *Strategy.* Principles are needed that describe how to methodically reach favorable strategic outcomes (sustainable development). The principles ensure that investments are linked to the goal of sustainability mentioned previously. The strategic aspect is satisfied by the prioritization of possible investments presented in a baseline of the process in question. Prioritization criteria is defined here by; backcasting, flexible platforms, return on investment, and the precautionary principle.

4. *Actions***.** Activities must be aligned to previous level principles. These are the actions that are developed after the consideration of the outcomes from level 3. Intrinsically they also strive to satisfy level 2 conditions. Taking the action to substitute a level one analysis must be done so show the affects that the choice has on less obvious variables.

5. *Tools.* Tools for initially measuring and then monitoring progress towards sustainability must be evaluated and used appropriately according there strategic purpose. Choosing which tool that is appropriate is dictated by the information presented at the different levels of the five step model. There are tools that signify when negative effects of human development in nature result in violations of systems conditions in level 2. Strategic actions presented in level 4 provide guidance to the choice of a tool specific to the goal of the intended action. The goal of the intended action is set strategically in level 3 which was created from systemic definitions in level 2. The result is a strategy support choice of a tool according to overarching principles of the level 1 socio-ecological system in which the intended tool was prescribed to fix.

7.2 Primary Analysis of wind power development using the FSSD model

In this section information regarding the impacts of wind development will be presented in relation to the 5 levels of the FSSD model. The conclusion of the model will be strategic actions that are supported by sustainability thinking. The Natural Step framework (NSF) will depict wind development in terms of national and global sustainability. The Resource Flows framework (RFF) is used to expand on the municipal implications both will be elaborated upon with examples from the two case studies.

7.2.1 *Level 1: System overview*

The ecosphere is the overarching system which the model is based on. This might seem trivial to try and define principles for this system due to its complexity. Taking an upstream approach it is not necessary to unravel the complexity of the ecosphere because only the ways in which human interactions degrade it is required (Holmberg 1995). This is the rationale behind using: the law of thermo dynamics, the principle of matter conservation, the principles of sun driven biochemical cycles, the inelasticity of the biosphere to sustain systematic shifts in its physical parameters, and society's dependence on resource flows from the ecosphere to describe this system. To classify these down to local sustainability and project development the following examples are given to include these principles within an overarching systems viewpoint for strategic planning.

To better relate the context of wind power development down to the local level reasoning for its global benefits need to be addressed. On a global level wind power is one of the renewable energy sources that will play a role in the mitigation of climate change (Hohmeyer & Trittin 2008). The European union has also chosen to specify the level that renewable energy should play in the future energy mixe by setting targets of 22% by 2010 (Directive2001/77/EC). Nationally Sweden has chosen a wind generation specific national planning goal of 15 TWh by 2015 and has been further advised by the Swedish Energy Authority to plan for 30 TWh by 2020.

Case reflections on systems perspective

The planning perspective from the experiences of Tanum municipality brings to light the importance of relating the global, regional, and local scales. Their view on the subject is based on a planning perspective compromise. Satisfying national targets driven by European and global concerns was a large contribution of how the municipality incorporated spatial considerations. The national targets and the government bodies that enforce them seen here play a large role when considering sustainability from the national and municipal scale. The Piteå case on the other hand related more to these levels as a way to justify how people think of the effects from development. Their experience has led them to believe that because they are the ones feeling the direct impacts of development the focus remains on the immediate and is hard to connect back to a global scale.

7.2.2 *Level 2: Defining success national and global sustainability*

Stepping down from defining the overarching system with its complexity, defining success is slightly more intuitive. This definition is derived from the four systems conditions or ways that can be used to stop degradation of the ecosphere (Robèrt 2000). With regards to wind power development the conditions can be identify as important because:

Condition 1: The main forms of renewable energy get their justification from not requiring harmful inputs like the extraction of hydrocarbons (oil coal) or the mining of uranium from the earth's crust (nuclear).

Condition 2: Wind power has no secondary emissions and does not contribute to pollutants such as CO_2, radioactive waste, or fly ash.

Condition 3: Wind power does contribute to degradation by physical means. For example wind power's main contribution comes from the impacts that development has on local ecosystems commonly represented by their effects on local bird and bat populations. (Kunz et al. 2007) Through a literature review (Langston & Pullan 2003) found that interactions between wind farms and birds can be categorized into three groups, disturbance due to displacement and barriers to movement, collision mortality, and loss of habitat due to the turbines themselves or of their supporting infrastructure. Bat mortality has been historically less documented compared to avian studies (Durr & Bach 2004). Migratory tree bats tend to make up the majority of documented fatalities (Cryan & Brown 2007). Researchers have different ideas as to the reasons behind turbine and bat collisions. They could be attracted to the turbines for feeding purposes, orientation problems attributed from the turbines audio output, or poor weather conditions (Kunz et al. 2007).

Condition 4: This is where most of the impacts from wind power can be categorized. This covers the social aspect of wind power development which is often most important when explaining attitudes and local perceptions. These aspects are more difficult to define because they are subjective. Landscape values, cultural impacts, power relations, and procedural aspects of sustainability justice, fairness, participation and access to democratic processes are all included under this condition.

Examples of these are relevant in wind development discourse. Landscape values are the most prevalent concerning attitudes against wind power (Thayer & Freeman 1987) (Khan 2003). Valuing a view or a certain landscape is incorporated into social sustainability through personal meanings and past experiences (Nassauer 1997) Views and aesthetics are also the ground reasoning behind the popular NIMBY or Not In My Back Yard concept. NIMBY assumes that wind power is supported as long as it is not sited where one has to interact with it. The inclusion of local factors carries more weight than the general environmental benefits of wind power (Wolsink 2000). In fact, Wolsink's (2002) study related NIMBY attitudes as only accounting for 4% of the variance in responses. Different levels of public participation can affect project acceptance. Early local involvement leads to more considerate siting and aids in the resolution of conflicts of interest (Khan 2003). Aitken(2010) warns that although the literature cites participation as a requirement or a best practice during the development process, participation must be defined as being involved in the decision making not just present for comments during a scoping process. During the beginning stages of the

development process local perceptions of process fairness and justice can create rifts in the municipally creating project winners and losers that ultimately lead to conflict (Gross 2007) .

Support from the cases: Bondön

Table 8. Piteå Case examples system principles

Principle	Description
1	Raw materials for Turbine
2	Oils, lubricants, paint
3	White tailed eagles, siting
4	Summer house owners, past development of hydro & timber, pace of tech progress, community compensation, industrial security, archipelago, recreation grounds, lighting, employment, tourism, landscape value

As Table 8 shows planners in the Piteå case mentioned eagles as the only environmental concern dealt with by a nesting inventory. It is interesting to hear that the number of eagles has been on the rise and has not had any negative effects with the project. Socially the major impact was on the neighboring summer cabin owners. It is interesting to see the shift in discussions since Bondön has been operational coupled to the plans for the Markbygden project. The public is now concerned with the pace of advancements in technology mainly the new size of the turbines. More emphasis is put on what the public gets in return for projects like this. This seems relatively quick considering that it took Tanum so long to progress to questions of compensation. This may be due in part to Piteå's natural resource development history that was brought up. The public views the north as exporting their forest and hydro power and want to make sure that through wind development they leave something for the future. This is especially important now because northern towns in Sweden have had problems with migration to the larger southern cities. Piteå is also interested in diversifying their industry but with options that will help sustain the town in case major industries relocate. It is topics like this that are not classified under an Environmental Impact Assessment but provide valuable context to the social situation involved with development.

Support from the cases: Huds Moar

Table 9. Tanum Case examples from system conditions

Principle	Description
1	Raw materials for Turbine
2	Oils, lubricants, paint
3	Siting
4	Swimming area, pace of tech progress, energy history, landscape value, community compensation, coast, recreation grounds, tourism

Comparatively Table 9 shows that Tanum's impact experiences are also better classified under principle 4. The replacement of turbines due to intrusion on the swimming area was the only concern that was mentioned out right as specific to Huds Moar. The pace of technological progress specifically the increasingly larger turbines was a concern with relation to their planning efforts and the impacts that it could have on the landscape values and finally on tourism. The historical experience that the municipality carried with them from their past energy discussions that was mentioned more than once is also unique and is worth noting to set the context for wind development.

Proceeding on to levels 3,4, and 5 using the NSF is not relevant to the study because of the emphasis that the NSF places on ecological constraints. To focus on the municipal levels the Resource Flows Framework will be used for the remainder of the analysis.

Table 10. Global national sustainability areas of wind power development impacts

Resource	**Merit**	**Resource**	**Merit**
Condition 1	+	Condition 3	+
Condition 2	+	Condition 4	-

Although these remarks are only generalizations of the classification of impacts and benefits from wind power Table 10 clearly shows that the national and global benefits of wind power using the systems conditions of TNS outweigh the negatives. This conclusion supports a need for municipal context.

7.3 Resource Flows Framework (RFF) Municipality sustainability

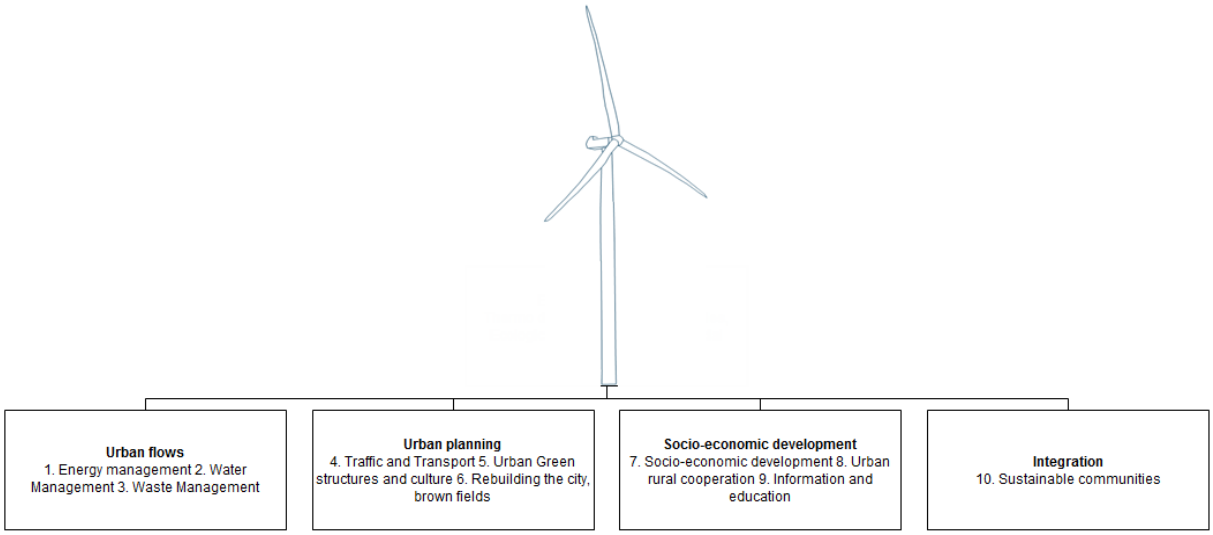

Fig. 7 RFF broken down into representative indictors

7.3.1 ***Level 1: System overview-*** The same results for the NFS Level 1 can be applied to the RFF as well.

7.3.2 ***Level 2: Defining success municipal sustainability***

It is at this point a closer look at the local or municipal scale is required. Impacts have greater meaning when taken out of the general (global national) scale and placed in the local system where they can be accounted for in more detail. It is here that the question of why municipal dimensions of sustainability are important to the wind development process is addressed. Each RFF frame criteria heading will be followed by an example of a core indicator(s) (see Fig. 7), positive or negative effects from the wind development process, and support from the two case studies. The positive designations signify municipal sustainability is enhanced. A negative signifies that development may have an adverse effect on municipal sustainability.

The information gathered in level 2 can be used for two purposes. First, it provides a base line for the sustainability situation to be used for the FSSD guiding framework. It should be noted that information like that provide in Table 11 is provided for explanatory purposes and only by conducting a full indictor inventory will the unexpected impacts from wind development be identified. If wind development's role is isolated in this assessment its contribution to the municipality's progress towards or away from sustainability is valuable information. Second, it can be used as a preliminary measure to provide a municipality inventorying of where development impacts or benefits can be expected.

Urban Flows

Energy Management ++ -

Indicators

- Total energy use

- Percentage renewable

- Carbon dioxide emission from municipality

Table 11. Energy management indicators for Piteå[1] *and Tanum* (Piteå 2009)(Tanum 2010)

Indicator	**Expression**	**Piteå**	**Tanum**
Energy use	GWh	6,500	550
% renewable	%	76	42
CO_2 emissions / person	Ton/yr	6	6.3

Of the three major divisions; urban flows, urban planning, and socio-economic development it would be assumed that the largest impacts would come from urban flows. These indicators are important in to providing a view of the metabolism of the municipality. That is, the resource flows needed to sustain the municipality in a functional capacity. Closing the resource loop, ensuring that production and consumption travel in the shortest distance possible is a systems principle that is strived for. This area is important because the energy can be captured from unused local wind resources to make clean power. It is important to compile this information from an energy flow standpoint to assess how much of an impact wind power will have on the renewable energy portion of the overall energy portfolio of the municipality. If the municipality has heavy industry they require more electricity which means they should have proportionally larger amount of renewable energy. Both of these points require subjectivity when taking into account that most major wind development's power is delivered to a nation / multinational electrical grid system[2].

[1] Piteå expressed in 2008 figures and Tanum in 2004

[2] It should be noted that most municipalities receive electricity from large national electrical grids where intermittent wind power generated electricity must be "blended" with more constant base load electricity sources. It would therefore be difficult integrating large amounts of wind generated electricity into existing municipal electrical systems.

Cases: Both municipalities sited being first interested in the development of renewable electricity for local consumption albeit not only for environmental reasons. Both cases also showed areas of concern for how they directly benefit from the electricity being produced. Piteå shows this through the public's questioning the actual benefit of the park due to rumors of low production due to technical problems. Tanum's questioning takes the form of justifications to the public in terms of contributing to national goals. Both municipalities stated the public's difficulty with connecting the local impacts to the national / global benefits. This also supports recent question of compensation. These and larger problems of acceptance might be solved had the electricity not been connected to the national electricity grid because the concept of direct energy use is easier to comprehend.

Past water management history can also prove to be useful. Tanum's rejection of the small hydro electric plant played a part in the decisions behind Tanum's acceptance of wind power development in general. Piteå's historic involvement with exporting hydro-power was important for how the public approached exporting wind power. Water management as a resource flow was then an important qualitative indicator that steered the public perception of wind development. Wind energy development was found to have no effect on waste management other than the fact that there is none generated during production.

Urban Planning

Urban planning includes all parts of the environment regarding transport systems, green structures, and the built environment that can be categorized under the municipality's MCP. Although wind power might not have an obvious connection to these flows systemic effects may prove interesting to monitor. For example the effects of branding a municipality as "green," might encourage more responsible development of the transit system and vehicle choices.

Traffic and transport +

Indicators

- Passenger number in public transport (number of travels per year) (best if for each kind of public transport)

- Emissions from traffic of CO2, CO, SOx, NO2, PM10 (tons per year in the municipality)

Case: Piteå can be used as an example as the presence of projects like Bondön as they show relatively few impacts few impacts on the municipality encourages municipal wide efforts for further expansion and a shift towards green industrial growth.

Greenery and parks management - -

Indicators

- Functionality (social) Make a list of the social functions that the green structures provide
- Impact on biodiversity

This is important to wind power development because impacts that should be accounted for stem from the most widely discussed aspect of wind development, landscape impacts. A measurement from the public's inability to use public green areas in the same way is helpful in assessing social sustainability aspects. Although not quantifiable in monetary terms these aspects have played major roles with regards to development permits being rewarded (Kempton et al. 2005). Impacts on biodiversity that were addressed under the NSF hold true under this section as well. An inventory of the area would be helpful for site prioritization.

Cases: There are instances to support visual impacts both project specific and for future development from both the case studies. The opposition in both cases comes from the request for protection of the views of the coast, cultural sites, or archipelago. Both cases also mentioned the visual effects on nearby summer cabins. Future development can also affect the town's character which was depicted as vital for tourism but also in terms of cultural identity. Tanum does not want to be known as having a landscape of wind mills oppose to a landscape with windmills. Piteå shows concerns about trading its green spaces for another opportunity to export its resources without long term benefits for the municipality. It should be mentioned that this indicator has room for expansion and could be developed to address specific issues concerning landscape values. Piteå would have to cite the white tailed eagle under impacts on biodiversity but biodiversity concerns are a social point of the required EIA process.

Rebuilding the city +

Indicators

- Functionality of built structure- Industrials / commercial areas (ha)

- New buildings on contaminated sites, brown fields (N; m^2 floor area)

This is important to wind development because it helps identify other benefits that hosting communities may receive both with the actual siting of turbines in a wind park and with the potential for the construction of factories to revitalize old industrial areas. These installations are also rather permanent seeing as how they are contingent on having an existing wind park. In the rare case that a production facility is built, the opportunity to place the buildings on brown fields is high because of the industrial synergies that are needed (shipping ports, main

roads etc.). Due to the small footprint of the turbines themselves they also disturb a relatively small amount of land (m^2) for the amount of electricity that is produced.

Cases: In Piteå project development warranted a service office which is placed in vacant industrial office space. This contributes to the functionality and diversification of the towns built environment. Although not buildings per se the siting turbines could be classified as revitalizing a brown field as in the case of Huds Moar being located so close to a gravel quarry.

Comments on urban planning & flows

With a presentation of criteria needed for municipal sustainability the impacts on the wind development process are raised. Similarities can be found between the indicators dealing with urban flow and urban planning. Both of these categories like the first three conditions of the NSF come from ecological principles. Rydén (2006) presents four strategies for the management of the urban flows and planning.

Reduction- Simply reducing the amount of electricity that is consumed or reduction of the impacts from that energy source is a management guideline. Reduction though could also be seen as reduction in the dependence of outside sources. Large-scale wind power would not be considered a step towards local energy independence with current policies but it contributes on a national level.

Replacement- Replacing non-renewable with renewable energy sources is a definite way that wind contributes to the replacement strategy

Rescaling- Wind power can be seen both as down-scaling from decentralized power sources but also as up-scaling from personal energy production.

Recycling- Recycling can both be applied to resources as well as spaces. Wind power helps close the resource to energy loop with the added benefit of minimal physical disturbance.

Urban Development

The final category that must be considered is urban development. Like condition 4 of the NSF issues of human interactions like culture, perceptions, and general well being are hard to include for a final general strategy. Instead, the concept of strategic integration is required. All of these three fore mentioned divisions of a municipal system must be measured against each other to determine where tradeoffs are to be made. This may be supported by both municipalities requesting compensation or being shown how they benefit in the long run. When taking into consideration that the main purpose of the city is to provide wellbeing for its inhabitants the difference between national and local sustainability are apparent.

The primary purpose for a municipality is service to the public. Services and programs provided by the municipality are intending to increase the quality of life for its citizens. Sustainability in terms of urban development promotes just this, how does the municipality contribute to a happy, healthy, and productive population? (Rydén 2006) Quality of life can be a result of economic wellbeing so a stable source of income is required but quality of like doesn't always have to be measured in this way. More socially driven aspects including neighbor relations, safety and a sense of culture are important. It is also important that the rural areas surrounding the urban centers they support are taken into consideration.

Socio-economic sector + - -

Indicators

- Socio-economy of individuals; labor force and employment

- Character of economy (% of total in each sector: agriculture, industry, services, etc.)

- Banking for local, regional and international investments

In a practical sense economic security may be a prerequisite before other aspects of sustainability are considered. Providing an individual with a sense of purpose and the ability to provide for themselves and a family helps make it possible for people to live in a certain area. This can be addressed by wind development by tracking the primary and secondary job opportunities that result from both the construction and maintenance phases for the wind park. Diversity in the economic make up of a municipality as mentioned before is also important to inhabitant's sense of security. On the other hand if project developers insinuate that there will be the possibility of new job creation in the community or if the job creation is not known the public may harbor feelings of distrust. The access to or absence of banking, especially opportunities for local investment, could sway public opinion as they take an economic interest in wind development.

Cases: Piteå's investment in the wind center and diversified industrial parks is a good example of how they see value in fostering a rich industrial makeup. On the other hand both Tanum and Piteå cited concerns for measuring just how much does the newly built wind park contribute economically. From the experience of the planning officials they were also relatively unaware of employment impacts on the community. In the case of Piteå a specific wind development company was noted as giving the public the opportunity to invest directly in the projects. This was seen as a positive and because it was announced at an early stage it may help gain public support and offer a clear answer to what the public stands to gain. This option was not available for either case.

Urban rural sector ++-

Indicators

- Working opportunities in rural region (No of working opportunities)

- Services and habitation in rural areas Agro-tourism (e.g. overnight, horse riding, fishing etc. No of person days/year)

This is important to wind development because keeping the surrounding rural areas alive brings benefits other than those from just resource services. The rural sectors are influential in supporting economic diversity efforts. Examples of this can be found by the United States allocating $99 million dollars to rural wind development (DOE 2009). From a social equality perspective the support of the traditional lower income rural areas is justified by renewable energy projects (del Río & Burguillo 2008). The cultural significance of rural support is also important especially in countries like Sweden whos history has been dominated by agriculture.

Cases: In both cases the wind parks can be considered as located in rural areas not far outside the city. Any locally employed service technicians, snow removal, or security personal would fit this category. In Tanum there was a concern about the wind park affecting a local business owner's horse tourism but this was eventually dismissed. This raises an interesting point when local entrepreneurs that make their living off of the tourist interest within the surrounding rural areas.

Education sector +++

Indicators

- Education and ESD in companies Certified (ISO 14001, EMAS) companies in the municipality (no. of companies/employees)

- Education and information to citizen's visits to demonstration sites in the municipality (number of visitors / year)

- Environmental/sustainability policy in the municipality (yes or no) / last example of use

New green industry job creation indicators can track a shift towards creating more environmentally conscious firms resulting from wind development. Encouraging test projects and offering places where the public can gather information are valuable additions to educating the public on possibilities for a municipality's future. It is important for wind developers to know if there is an environmental/sustainability policy because it signifies that the public / planners see value in incorporating sustainability into municipal decisions. This may also lead to a more informed public regarding spatial considerations of sustainability. An

addition was made to this set of indicators to help identify if sustainability policy is regularly used.

Cases: Tanum presents a good example with its early placement of turbines which allowed the public and planning body to gain invaluable experience when it comes to future issues concerning development. Piteå shows this with its wind power center with one of its main purposes being public information and education. Piteå and Tanum both fulfill the environmental / sustainability information criteria, Piteå by being a part of the sustainable cities programs and Tanum by recognizing Local Agenda 21 planning in its decisions making. Both cases stated that they would like more help connecting spatial issues, this may be a sign of the effectiveness of these programs. Piteå's involvement in the sustainable cities project was not mentioned as a crucial aspect during planning considerations.

Participation - - +

Indicators

- Number of opportunities public opinion is considered during formal municipal procedures

- Presence of organized dissatisfaction in media

This type of indicator was left out of the RFF but as mentioned before customization within the framework should be done as long as it is based on prominent evidence shown here by participatory dimension sustainability discourse (Sneddon et al. 2006). These types of social indicators are relatively hard to measure quantitatively.

Public opinion is usually built into municipal planning process in the form of scoping sessions. It could happen that a project is exempt from these formal procedures which results in a less democratic process. Even if the opportunity for public input is there the actual perceived value of input can turn the public against a project (Khan 2003).

Cases: Tanum and Piteå both recommended that the public's opinion be respected and acted upon during the development process. Tanum also reflected on a historical occasion where the town exercised their democratic right against a state proposed nuclear plant. The opposition was strong enough to match the power of the state and finally resulted in the project being denied. Both cases responded that public has generally accepted the wind parks so it can be implied that this requirement was fulfilled in both cases.

7.3.3 *Level 3: Strategy and principles for strategic investments*

Level 3 outlines principles needed for a process to meet sustainability. A methodic prioritization will be performed on the areas listed above to find which are most relevant for

both sustainability and wind power development process. This will answer research question one[3].

Backasting- The first process of prioritizing measures performed is the identification of criteria needed for the future so that actions now can be selected to achieve this vision. This is called backcasting and differs from forecasting outcomes because it frees planners from the confines of today's influences (Holmberg & Robèrt 2000). The business rational for backcasting is supported by the ability to deal with the conflicts between short and long-term goals, plan proactively, and foster new and creative solutions. This also coincides with Hart (2003)'s key dimensions of shareholder value. The vision of local sustainability that was backcasted from are the RFF indicator target levels in level two. This fulfills the backcasting criteria needed for all indictors to precede to the flexible platforms stage.

Flexible platforms- Investments of time or other resources need to be justified in terms of how they set the stage for future investments. A municipality needs to see why a wind project is a step both in the right direction as well as an opportunity for something larger. In relation to wind power development, processes must lead to more value from a sustainability standpoint. This is where the merit category of Table 12 is presented. Each area of sustainability set by the RFF is given a merit judging by its positive or negative impact. By answering this question developers can also identify which of the options has the most likelihood of leading to a state of increased sustainability and as a result a more secure business decision.

Table 12. Local sustainability resources of wind power development impacts

Resource	**Merit**	**Resource**	**Merit**
Energy Management	++ -	Built environment and revitalization management	+
Water management	+	Socio-economic sector	+ - -
Transport and traffic management	+	Urban rural sector	++ -
Greenery and parks management	- -	Education sector	++
		Participation	- - +

Developers can identify areas for change in their development process and then choose which interjection points are most likely to be applicable in new markets. For example if it is

[3]Question1: There is *strategic* value in planning from a sustainability perspective, how can it be identified in the wind power development process?

concluded that both; more public participation earlier on and a change to a more comprehensive impacts assessment process like SEA contributes to sustainability, they must be prioritized. Choosing the participation option may turn out to be a larger step for the future because it requires less resources and more participatory processes might be needed when developing projects in mature markets or international situations.

In the case studies greenery and parks management, socio-economic sector, and participation are chosen as examples. The aspects of sustainability that contribute to both of these indicators will then have to be applied to the appropriate phase of the project development process.

Good return on investment- The final strategic criterion for this prioritization is to choose the option with the best return on investment. The short-term constraints that most businesses and municipalities face are acknowledged here. There should be a distinction between the two. Municipalities generally can accept longer term investment criteria due to the fact that they are publicly supported and are assumed to have rather long lifespan. Return also does not need to be represented by money. Return can be thought of as successful processes that contribute to a project's acceptance or step towards a more sustainable municipality. For the purpose of this study a detailed analysis to decide which of the options is more likely to lead to a better return will not be done. It is perfectly fine to continue with all three seeing as how these examples were are generated from planners experiences. To be able to make more substantive conclusions a full indicator inventory or another form of baseline review would be required for Piteå and Tanum.

Precautionary principle- A general overall principle when the connections to the 4 systems conditions are questioned is the precautionary principles which acts as insurance for the three principles listed above. From a municipality's standpoint when the decisions are not completely clear and there is a large chance that an action may result in a misuse of resources or entail large impacts precaution should be accepted or even expected. This is supported by Tanum's wish to slow the development process down and wait to see what happens. Presenting information to lessen the perceived risk of a decision for a specific project may be a way to accommodate this viewpoint.

7.3.4 ***Level 4: Action***

The three strategic areas, greenery and parks management, socio-economic sector, and participation identified in earlier sections must now be applied to their corresponding parts in the development process. The first step is to unbundle the aspects that were mentioned during the cases that made these indicators important to municipal sustainability.

1. Greenery and parks management: Landscape values

2. Socio-economic sector: Compensation

3. Participation: Inclusion of public opinion

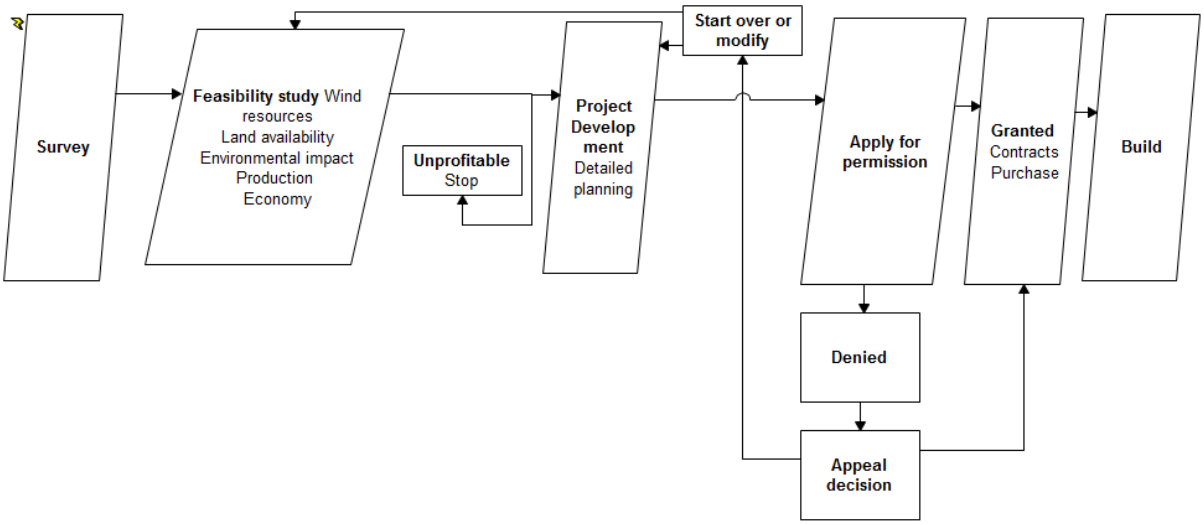

Fig. 8 Description of the wind power development process (Wizelius 2007)

The second step is to place where in the wind development process (Fig. 8) the aspects come into play.

Wind development process

The wind development process begins with a survey of meso-scale wind resources. After an area is chosen an in-depth search is made and options are prioritized by; access to the national electricity grid, suitable road access, and areas of known special interest. When a potential site reaches this stage a preliminary park layout design is made and the appropriate land owners are contacted to secure land lease agreements. Wind measurement instruments are erected in the project area so that data can be collect to determine electricity production and ultimately project feasibility. After a year, or less depending on the data and measurement equipment, a series of project feasibility studies are performed. The economics of the project usually determines if the project developer beings assessing the environmental and cultural impacts with an Environmental Impact Assessment (EIA). Depending on the local EIA procedures the first two steps are; screening to decide if a full EIA is needed and scoping to included the input from the public hearing (Appiah-Opoku 2001). If the project is still economically feasible after public input and recommendations from the various other feasibility tests detailed planning can begin. Depending on when the developer chooses to file, the formal permitting process beings and the permitting public hearings are held. Changes to the project plans are made to fulfill suggestions or requirements and permission is granted. After

permission construction contractors can be chosen and orders for the wind turbines can be placed.

Landscape values

Going back to the case studies landscape values were accounted for in Piteå during the first scoping session during initial energy discussions in Tanum. Landscape values are also formally addressed during the EIA process (Ung 2005). Landscape values historically have been addressed by moving turbine positions to reduce visual impacts or painting them less obtrusive colors to blend in with their surroundings. In Tanum's case the planning department suggests grouped areas in their MCP so that wind turbines do not dominate the landscape. Not seeing a decrease in tourism and lack of negative feedback from the community suggests that this action was effective. From a sustainability standpoint if these landscape effects cannot be minimized then more focus must go to providing the community with justification for what they receive in return for their views. It should also be noted that both cases confirmed an increased awareness of landscape values for future development: Piteå with its media experience and archipelago issues, and Tanum with their special awareness in their planning goals.

Compensation

The issue of compensation which is present in the socio-economic sector of sustainability and can be found in the local perception of impacts and benefits presented in the Piteå case. Tanum lists it as a precursor to further impacting the landscape values associate with the world heritage site. Compensation is also supported by both case studies, both as gaining popularity when future plans of development are discussed and as an area they would like to be more knowledgeable in. As far as the development process is concerned this issue can be illustrated by presenting the findings from level 2. By presenting the possible sustainability impacts that municipalities receive developers show that they are considering what the municipality stands to gain or lose from the resources it has given up. For a monetary approach creative financing methods may be used to gain local support by giving them the choice to be financially involved in the project. In the development process these actions should be presented at the initial public hearings, or even sooner using the public equity offering example in Piteå.

Participation

The final issues that need to be addressed are aspects of participation, mainly the issues of inclusion of public opinion and respect. Lessons learned by Piteå during the development process identified that good developer-public relations especially with regards to indigenous interests and respect are important. These can also be related to how involved the public feels in the development process (Gross 2007). Tanum's public outcry against nuclear power is a good historical example of what can happen with the public is not behind a project. Public

opinion might not seem like it plays a definite role until the public opposes something. That is why it is better to take a proactive approach to inform and incorporate the public so that they feel like development is a shared process. To include this in the development process both public hearings and proactive situations where information can be provided are valuable. The issue of respect can specifically be considered as something that should occur during the whole development process. To identify a specific area in the development process the public hearings are the best places to exercise respect. This can be done both at the meetings and when it comes seriously considering their suggestions in the detailed planning phase. Care should also be taken to show that the public's concerns are being taken seriously.

To summarize, there are two possible areas that occur relatively early in the wind development process where the value of sustainability assessment can be implemented. The first is where information is either presented or gathered from the public. The second is where existing assessments can be added upon to include more socially relevant factors of development. The impacts from wind power and the main areas for action both deal heavily with social aspects of development.

7.3.5 ***Level 5: Tools***

Before strategies can be put into action there should a short discussion about the tools that are currently used in the wind development process and those that are needed to measure, manage, and monitor the progression of these strategies to keep them aligned on the path to the success level. For measurement, sustainability indicators were used to provide the baseline for assessment. Baseline data gathered for indicators might also be more easily translated to the public if it could be conditioned to fit the criteria to show the Ecological Footprint of the municipally. Indicators are also helpful during the monitoring phase to track the progress or impact that the park has on the municipality's sustainability targets like with the Atkisson Compass.

Another form of measurement that would be specifically useful for energy source comparisons is LCA. LCA can be used to compare wind power to other possible development alternatives. An example of this is a 3MW offshore Vestas V-90 turbine which accounts for all inputs required to produce the turbine, its tower, the rotor and blades, and the foundation it sits on. The functional unit used in this LCA is 1 kWh of electricity so that results can be compared to similar electrical production. Results show that the payback time needed for a 3MW Vestas V-90 is around 6.8 months (Vestas Wind Energy 2006). This means that driven by the nonexistent production of CO_2 during its operation the turbine it able to reimburse the energy associated with the materials for its production in are 7 months. For reference the same LCA for an onshore turbine of the 2 MW class figured in with a payback time of 9 months. Assessments also assume site specific details such as transportation, inclusion of local conditions generate different results. To assess the material inputs specifically MIPS could be used to aggregate the utility service of each turbine. This could then be used to compare like

energy sources in order to help assess if the development would be within bounds of the chosen sustainability framework.

Table 13. Missing sustainability components of EIA

Source	**Description**
(Wilkins 2003)	Subjectivity compiling the prediction aspect, the interested parties perform assessment
(Hacking & Guthrie 2007)	Environment narrowly defined, social aspect excluded
(George 1999)	Lacks intra/intergenerational equity components
(Shepherd & Ortolano 1996)	Narrow focus on short term land use planning, strategic, plan, policy considerations. Process "starts to late, ends to soon, and is too site specific"

The tool that is currently used for impact measurement is Environmental Impact Assessment (EIA). This is the portion of the wind development process where considerations and assessments for future project impacts are predicted. Noted objections to the EIA process from a sustainability perspective are represented in Table 13. Pertinent to the studied cases EIA is the preferred method for project impact assessment according to chapter 6 of Swedish environmental code. EIA has been used worldwide and if left as the only measure of project impacts fails to incorporate all impacts associated with sustainability (Bruhn-Tysk & Eklund 2002) (Wilkins 2003). These faults can also be coupled with the Swedish permitting process as Khan (2003) finds that in certain circumstances the process restricts public participation. These conclusions are specifically relevant to the wind development process because of the value associated with accounting for impacts and presenting information during the EIA process.

Management tools like ISO 1400 and EMAS can be put in place to organize and manage the improvements to the wind development process that were made. This might also be beneficial for the development companies to formally certify themselves after implementing new process for sustainability. To conclude the Sustainability Balanced Scorecard is useful in justifying to corporate management why the added resources should be used to perform more sustainability bases assessment when developing wind power. Management might also be able to align other processes within the organization.

8 CONCLUSIONS AND DISCUSSION

8.1 Contributions

Theoretically

Method-wise the results of this study have contributed to similar studies that aim to draw connections between the existing tools available for assessing sustainable development (Hacking & Guthrie, 2007;Robèrt, 2000; Finnveden & Moberg, 2005; Ness et al., 2007; Pope et al., 2004). In this regard by taking into account the general conclusions from their findings and applying them to wind power development specifically in Piteå and Tanum new information was created. Through the analysis this study also contributed to discussions on placement and fit of different higher level assessment techniques. The study shows that different tools, frames in particular, were needed when evaluating municipal sustainability. This study also contributed to a working application of the FSSD framework to both the municipal and wind development contexts. Aided by the RFF the study helped show the differences between the spatial dimensions of sustainability.

Practically

Practically this study's main contribution was a presentation of an operational definition of the term sustainable development and how it can be related to business. In particular it presents the possibility for strategic planning for sustainability which can be classified as a *integrated* example of corporate social responsibility for the case of the wind development process. By assigning value to the concept of municipal sustainable development higher level strategic business decisions may have a better chance of incorporating or at least evaluating business processes from a sustainability perspective. By expressing where value can be created by thinking of sustainability it legitimizes it as a long-term business strategy. This was exemplified by the wind development process and can be used more specifically during the site selection phase. This approach is most relevant to similar findings supporting the successful strategy of site selection on a sociological basis by a wind development firm in England (Toke 2005).

Research limitations & recommendations

The exploratory nature of this study presents opportunities for further steps in the research design, for example hypothesis building regarding the exact relationships between wind power development and municipal impacts. The qualitative sample data that some of the main conclusions are supported by is also a limitation. Experiences from municipal planners were not the only intended sources for information. A survey was created to help generalize the

conclusions from the two case studies but there was an insufficient amount of replies so it was excluded. In that sense this study only served as a theoretical justification and through the case studies further data should be gathered to be able to generalize for process specific recommendations.

8.2 Summary of findings

1. There is *strategic* value in planning from a sustainability perspective, how can it be identified in the wind power development process?

The results that answer research question 1 are based on the methodological conclusions from the study. First, the appropriate frame was chosen to represent and operationally define sustainability. The problem with frames is that they are intentionally customizable. By using the TNS framework and taking examples from wind development in the literature and case studies it was found that wind power is beneficial from a sustainability standpoint by having 3 out of the 4 conditions in its favor. But because not all wind projects get permitted this must not be the case.

To find the real value from a sustainability perspective a second frame was needed. One that is still customizable but less so because it focuses on municipal constraints. An example of a measurement tool was also used to show how this frame would be implemented in practice. The conclusion from the data gathered from the two case studies was that three areas of municipal sustainability and their corresponding attributes were affected by wind development:

1. Greenery and parks management:	Landscape values
2. Socio-economic sector:	Compensation
3. Participation:	Inclusion of public opinion

The framework took complexity out of decision making by stepwise relating every decision back to the previous level until it was justified by the operational definition of sustainable development.

2. How can this value be *integrated* in the current wind power development process?

The level 4 action portion of the FSSD model addresses research question 2. It was found that for landscape values grouping effects should be considered while initially surveying sites. If landscape impacts cannot be avoided then it is a question of presenting the options available for compensation. These options could come from the other positive sustainability impacts that the project brings or from examples given during the RRF indicators and especially those under the socio-economic sector indicators.

This leads to the next opportunity where value is integrated, presenting compensation. Compensation should be addressed early in the development process. The topic is steadily gaining popularity so a proactive position should be taken to communicate what the community stands to gain from the development. This information could come in the form of running through framework checklist like presenting the results from the plus merits from the analysis or finding solutions for the minuses during the site surveying phase. Monetary compensation should be considered while calculating the economic feasibility of the project to possibly include public ownership options.

The final inclusion of the public opinion was also deemed a proactive solution. It should be addressed even if the project is included in a MCP and does not require the public hearings of a DDT. This is backed by the same reasoning given for the compensation, the faster the public can relate to some kind of ownership in the project or process, the fewer possible major demonstrations against the project. It should also be pointed out that true public participation is judged by indications from the public. The faults inherent in set development processes can create the legal justifications for participation but if the public does not deem it sufficient local sustainability will suffer and the risk of strong opposition may increase.

3. How do sustainability aspects relate to the *local* level (Municipality sustainability) and national and international levels (national sustainability etc.)?

Local municipal sustainability was found to differ from requirements for national and global sustainability. This was shown by the approval of wind power on the sustainability grounds set by the TNS frame. The ecological benefits outweighed the social impacts on account of the spatial dimension. These spatial impacts are greater when taking a municipal standpoint. The RFF was needed to recognize the systemic impacts that development at that level would have. Only when this was done could areas of interaction be identified and be accounted for by a greater proportion in the assessment.

8.3 Final comments

One of the main benefits of using sustainability analysis is that it places the development process within its systemic context. Depending on the aspects that need to be considered, deeper life cycle assessment can provide information on the resource flows that the project requires. The resources that flow from the human or social spheres are not always easy to measure. By compiling a diverse set of tools the value from these different resources can be better accounted for and related to its context, resulting in better long-term decisions.

A fair amount of pressure is put on the energy decisions that are being taken today because of unseen long-term impacts of the past. No project is without its impacts and these impacts vary depending on local contexts. More land is required to support a bio-mass installation, wind turbines require changes in the visual landscape, and hydro-power has a mixture of both. It is the local context where these impacts are felt the most. When energy generation is site

specific these local effects carry more weight when competing for project local permission. So as competition increases for permits project developers will have to differentiate themselves strategically. Prioritizing projects in terms of their impacts on local sustainability is a way to do this. This plays in the favor of the municipalities that feel an obligation to contribute to energy supply and the developer who can forecast more than just possible areas of resistance. One only has to look to the development of hydro-power, the last example of large scale renewable energy development as a guide.

It is difficult for national level planning to anticipate some of the more detailed local impacts. To avoid similar mistakes the short comings of impact assessment tools should be realized and improved upon proactively. This can serve a double purpose by incorporating the interest of local communities at the same time. The inclusion of these systemic connections is especially important with the pressure that is placed on our energy decision's impacts on the future.

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Appendices

Appendix 1: Interview purpose

Overview

Thesis purpose: To see how in the wind power project development process sustainability thinking will benefit a community's long term sustainable development

Research questions:

1. There is added strategic value in assessing wind power development from a sustainability perspective, how can it be identified?
2. How can this value be integrated in the current project development process?

Methods: Case study, interview, system diagram, and discussion

<u>Today:</u>

Purpose: Experiences with wind power:

Past (pre-wind park)

1. Diagram the process that permitting a wind park goes through (discuss)
2. Label interactions between interest groups
3. Relate to the project specifically

Current

1. Update process with ways it has changed.
2. What has changed and why?

Debriefing

Appendix 2: Personal interview guide

Overview

Thesis purpose: To see how in the wind power project development process sustainability thinking will benefit a community's long term sustainable development

Research questions:

3. There is added strategic value in assessing wind power development from a sustainability perspective, how can it be identified?
4. How can this value be integrated in the current project development process?

5 (13:30) Introduction: Self, thesis, purpose, agenda

5 (13:35) Methods:

Case study- research/exploratory, how and why something in real life works the way it does. Triangulation. Generalize findings to a theory NIMBY. Karl-Henrik Robert framework, strategic sustainable development

Interview system diagram, and discussion

<u>Today:</u>

Purpose: Experiences with wind power:

Past (pre-project)

4. 10 (13: 40) Diagram process permitting a wind park goes through (discuss)
   12 (13:50)
   a. Place renewable energy source evaluation, next alt. does it affect permitting?
   b. 'Past experience / guidelines energy infrastructure (hydro)
   c. Place source of vision (doc) for future. Definition of SD,
   d. 'Think of sustainability, local, regional, national?
   e. 'Why special centers? Did industrial make-up play a role?
   f. Most time intensive? Can this be improved, how?

5. 14 (14:02) Label interactions between interest groups (General, project?)
    a. Reoccurring issues or interest groups wind in general?
    b. Place largest competing resource
    c. Account for landscape values, how?
    d. Account for social impacts, where (only EIS) how?
    e. Place public participation, in addition to regulations?
    f. Who participates? Live within area? General public?
    g. Information availability

6. 14 (14:16) Relate to project specifically
    a. Place differences from standard regulations
    b. Place Initial concerns
    c. Place participation, satisfactory amount? Formality or taken into account?
    d. How were concerns mitigated?
    e. How positives (collective) of project accounted for? Or only negatives?
    f. Account for social impacts, where how?
    g. Existing similar landscape alterations?
    h. Economic benefits distribution concerns?

Current

3. 5 (14:30) Update process with ways it has changed.
    a. Any system for feedback?
    b. Used outside information?
    c. Has larger project experiences affected how smaller projects are evaluated?

4. 5 (14:35) What has changed and why?
    a. Lessons learned?
    b. How communicating these experiences?
    c. Helpful to learn from similar cases?
    d. % of work delegated to wind?
5. Place where, who benefits most from of your development? Local, regional, national?

5 (14:40) Debriefing

14:45