

Implementing Integrated Renewable Energy Systems in Greenland

- Potentials and Constraints

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Abstract

In 2001 the Greenlandic Home rule obligated itself to reduce the CO₂-emissions with at least 8% compared to the situation in 1990. The development since 1994 clearly shows that it is getting increasingly difficult to reach these goals, and that the present system of planning, energy plan, energy system and attempts of implementation have been utterly insufficient. Based on an analysis of the development within the Greenlandic sector of energy up until now, a new and considerably improved system of planning, energy plan and process of implementation is being constructed and suggested with the town of Sisimiut as case study.

Resumé

I 2001 ratificerede Grønlands hjemmestyre Kyoto-protokollen. På denne måde forpligtede Grønland til at reducere CO₂-udledningerne med mindst 8% inden år 2008-2012. Udviklingen fra 1994 til nu viser, at det er meget tvivlsomt om dette mål vil blive nået. På basis af en grundig analyse af samtlige energiplaner i Grønland siden 1981 og op til i dag, er de væsentligste barrierer og potentialer identificeret. I et forsøg på at komme et skridt videre sammen med lokale aktører og energiplanlæggere, foreslås ændringer i energisystemet, energiplanlægningen og implementeringsprocesserne. Yderligere foreslås en operationel og dynamisk model - med Sisimiut som eksempel - som et redskab til disse udfordringer.

1. Framework

Development of renewable energy systems (RES) in rural areas is challenging, and requires special attention. Distances and limitations in infrastructure may be a hindrance, or at least become a substantial cost element in connection to regional or national power-grids. Similarly, both components may be added to the cost of running stand-alone systems, just as there may be limitations to scale-efficiency of such systems. With emphasis, however, on renewable energy resources, there may also be substantial benefits to gain – available local renewable energy resources that may contribute to a coherent or stand-alone system of integrated renewable energy. Partly due to the fact that there may be local resources available, for instance in relation to biomass and waste materials, and partly to potential exploitation of wind and water based energy resources may contribute to a situation where a coherent system of integrated renewable energy exploitation may become a sustainable and cost-effective approach to rural energy supply.

Renewable energy systems (RES) must be developed in relation to the existing energy systems. The existing energy system is not always, but often, isolated in the Westnorden and Chinese periphery. This is due to the fact, that the infrastructure is isolated. Most of the local renewable energy sources is not always situated near the settlements. This may have the effect, that establishing new infrastructure components is relative high. However, renewable energy sources are often free or cheaper than the existing fossile energy source.

Cost-benefit analysis between a fossile based and renewable energy based energy system must include all this economic components. Whether renewable energy is more cost effective in smaller or a more peripheral settlement than larger and more centre orientated settlements is interesting to investigate more closely *in situ*. These cost benefit analysis are based on many indicators, witch may chance over time. Therefore the potentials for implementing a renewable energy source/or technology is not static but may change over time. This indicates that it is necessary to have ongoing scientific investigations on this field.

Potentials for implementing the local renewable energy sources is that they can play an important role where it is difficult and cheaper than fossil energy. Beside this, the local or regional stakeholders may need or wish to promote RES in areas where it is not yet cost effective.

Even they are geographically distant, and based on very different historical and political conditions there are a number of similarities, which makes a comparative study both relevant and worthwhile. The natural conditions, the settlements structures and the system of planning may differ in the Vest Nordic regions. In all cases the nature is an important factor in relation to both infrastructure and energy potentials. They are all more or less "remote" and exposed to the ongoing climate changes in such a way that responsiveness is necessary. All the settlement patterns are more or less characterized by insularity, and therefore may an improved system of planning, energy planning and the processes of implementations that functions well in one setting, probably be applied in the others as well.

Local renewable energy supply is a step towards self-sufficiency and sovereignty and sustainable governance. Every independent state is seeking after or has gained self-sufficiency regarding energy supply, minimizing the vulnerability of foreign states. Therefore sustainable governance and promoting renewable energy and renewable energy technologies is a concrete tool towards one of the ongoing topics of the Vest Nordic countries and Chinese provinces.

The research question is therefore relevant: How can we measure whether a specific renewable energy technology is a sustainable and cost effective approach to isolated energy supply in the Arctic periphery?

2. Task

The main task of the research project is to analyze the possibilities and perspectives of developing integrated energy systems based on renewable energy, as a transition from fossile energy based systems, in order to move towards local or regional energy systems more or less based totally in renewable energy. There may be different approaches to such an analysis, but in this project it has been considered relevant to focus on 3 major types of planning situation, where:

- (a) hydropower will supply the energy system totally, and other renewable energy sources could not be implemented
- (b) hydropower will supply the energy system partly, and other renewable energy sources should contribute
- (c) Hydropower has been planned not to be implemented in the energy system within the next 15 years, and other renewable energy sources should be implemented.

For each of the three planning situations, different strategies in the system of energy planning, energy plan and process of implementation must be made.

In relation to the development of renewable energy systems at the technical and systemic level, it poses the main question of the socio-economic and political conditions for the implementation of such systems.

Sustainable governance of renewable energy sources need to considerably improve (a) the system of planning, (b) the energy planning and (c) the process of implementation.

3. Task - Sustainable Governance

What are the Constraints and Potentials for Integrated Renewable Energy Systems characterized by 3 types of energy systems, and exemplified by two different regional cases in The Westnorden.

The main task of the research project is to analyze the possibilities and perspectives of developing integrated energy systems based on renewable energy, either:

- (i) from scratch, or
- (ii) as a transition from a system of planning based on fossile energy sources and technologies and centralized production and planning.

Sustainable governance therefore needs to considerably improve

- (a) the system of planning,
- (b) the process and energy planning and the energy plan and
- (c) the process of implementation.

Each of the tree themes need to be analyzed and considerably improved, before the transition process towards sustainable governance may occur.

From a *planner's* point of view, the overall task is to analyze the possibilities and constraints of developing a system of planning, energy plan and process of implementation witch can change the focus towards quantitative objectives for environmental impact and use integrated renewable energy technologies and use and local renewable energy sources, in order to reach the objectives. The planning methods must be robust (dynamic and operational). Therefore a model is needed. A model that may show to the planners and policymakers the status, forecast the effects and it may function as a tool for prioritizing. The model is made operational, showing the dynamic nature of the energy system.

The key to successful adaptation is appropriate regional government for sustainable development and regions need to explore alternative energy to deal responsibly with the unavoidable contract between the center and the periphery. They need alternative sense making devices to understand the different ways in witch sustainability is perceived in the center and periphery. Energy and climate policies

are embedded in a complex social-ecological system (SES) made of energy resources, a multi-scale governance system, and associated infrastructure. Key performance criteria for energy and climate policy are sustainability and robustness.

The system of planning consist of the framework of the planning (legislation, technical structure and policies, economical barriers, tradition and so on) and it deturns the framework and aim of the process in witch the written energy plan is carried out and the involved stakeholders.

The written plan deturns the aim, actions, stakeholders and therefore the process and the success and the process of implementation. This indicates that all parts of the planning process need to be changed if a government vans to reach new environmental goals.

The variety of the infrastructures, energy systems, stakeholders and local energy resources, policies in each region, makes it necessary to discover new procedures for each of the tree described themes in each new region.

From a *researcher's* point of view, the task is to provide information about this main tasks and knowledge-based tools for the planners, politicians and local stakeholders to make the transition operational and make the stakeholders realize that the process of transition is in there concern to participate in the process of transition.

In relation to the development of renewable energy systems at the technical and systemic level, it posses the main question of the socio-economic and political conditions for the implementation of such systems.

4. Model – a knowledgebased planning tool

On this basis, a modeling has been made. The model may functions as a planning tool for determining both status of the energy, material, economical and pollution flow of the energy system. The model also functioning as a tool for precondition of the economical, technological and environmental effects if a specific renewable energy technology is implemented. In addition to this it may function as a tool for prioritizing efforts. This is very helpful for energy planners and local entrepreneurs.

Consequently, the model also shows the main political socio-economical constraints and the system of energy planning and the energy plan.

Sisimiut in Greenland is chosen as a case study, because it is the only energy systems in Greenland, where a technological, economical and environmental model of the energy system has been built. It is the energy system in Greenland where the natural and technological potentials has been determined for almost all types of renewable energy sources.

On the basis of the model, the project will show what renewable energy entrepreneurs and planners could be aware of when they seek to implement a specific renewable energy technology in a specific energy system. Furthermore – on the basis of the model of Sisimiut and the results of the analyze of the system of energy planning, energy plan and process of implementation, a new and operational EnergyActionPlan Greenland 2005 – 2025 is made (Palvig, 2008).

5. Outcome and Perspectives

The outcome of the project will as a minimum be:

The local Government (The Greenlandic Home Rule) will gain:

- a characterization of the existing energy systems and planning
- a mapping of the major localized renewable energy potentials
- a characterization of the major potentials and constraints for making a transition to developing a energy system based on integrated renewable energy technology and renewable energy sources.
- a dynamic and operational model of each energy systems which can function as a tool for prioritizing activities
- a action item list of constraints for IRES, to be dealt with
- proposals for a strategy towards a more sustainable energy systems situations

The Westnorden region will gain

- Contributions to their present ongoing discussions regarding moving towards renewable energy supply
- Potential partnership in connection with the Interreg IV initiatives and funding opportunities.
- A concrete and operational methods/model/planning tools for the efforts of implementing IRES in the Westnorden.

6. Literature

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