Information design as a tool for promoting renewable energy

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Abstract: Information design has become a tool to enhance the communication of process- and systems-oriented information. Environmental awareness can be promoted through information design (Bartusch & Porathe, 2011). With regard to renewable energy, these aspects of information design need to coincide. Renewable energy sources play a key role in the EU’s circular economy package and energy policy targets (COM, 2015). Also rural actors should be encouraged to use renewable energy (Chel & Kaushik, 2011). They should have access to simple and comparable information. Well-executed information design when planning, shaping and visualizing data could provide solutions for this dilemma (Coates & Allison, 2014). This paper deals with the opportunities of using information design as a tool to process and produce more understandable information about rural renewable energy possibilities to better meet the information needs of rural actors. In this study, data is produced in two forms of visualization: posters and animations.

Keywords: information design, visualization, renewable energy resources, consumer

1. Introduction

Information design is a tool to enhance the communication of complex systems. Data visualization, data wrangling and narration are methods of information design which aim at making data easier for the users to interpret. Environmental awareness and behavioural change can be promoted and strengthened through information design (Bartusch & Porathe, 2011).

Information about renewable energy is complex. Economic, environmental and social impacts affect the decision making of consumers but these different aspects of renewable energy sources are hard to compare. Consumers play a key role in promoting the use of renewable energy sources, which are an essential factor in moving towards circular economy (COM, 2015). At the same time, there are a lot of possibilities to produce renewable energy at the local level. The countryside holds plenty of
This paper presents innovative opportunities of information design in order to promote the utilization of renewable energy resources in the Finnish countryside. Through the methods of information design, clear and understandable information is produced to activate the consumers to find out more about renewable energy and eventually make investments. Two types of visualizations to promote the utilization of horse manure in heat and energy production on Finnish horse farms are presented.

2. Approaches and methods
2.1 The potential of renewable energy in Northern horse farming

The EU adopted the circular economy package at the end of the year 2015. The aim is to promote the transition towards a more circular economy model where renewable natural resources have a significant role. (COM, 2015.) Moreover, renewable energy sources are key factors in the EU’s energy policy targets. In 2012, the share of renewable energy was 13% of final energy consumed. This share is expected to rise further to 21% in 2020 and 24% in 2030. (COM, 2014.) Agriculture is one of the main users of fossil fuels in the Western countries (Bardi, El Asmar & Lavacchi, 2013).

In a circular economy the flows of materials and energy are effective, and a shift towards the use of renewable energy is accelerated. In achieving circular economy, the consumer is in the core. Currently, several factors are showing a change in consumers’ attitudes, and at the same time for example new innovations and technological solutions are making circular economy more attractive. (Ellen MacArthur Foundation, 2013.) However, a comprehensive knowledge of renewable energy sources is required to support the decision making of consumers (COM, 2015). In addition, it is worthwhile to point out that the countryside has great potential for renewable energy production. Thus, as Chel and Kaushik (2011) point out, rural actors should be encouraged to use renewable energy solutions such as biomass energy.

The equine industry, i.e. horse farms, is a growing part of agriculture. Former research shows that the number of horses tend to rise in correlation with the consumption level and the education level of the population. In the meantime, the number of horses kept near cities and urban areas has been steadily increasing in Europe for the last decades. (Liljenstolpe, 2009; Hollmén, Laitinen & Louhelainen, 2012.) According to Hadin and Eriksson (2016), the concentration of horse stables has led to a situation where environmental problems can arise, if there is not enough arable land for spreading horse manure, or either the methods or capacity for manure storage are inappropriate.

Horse manure is defined as waste but can also be utilized as a soil improver, fertilizer and as a source of renewable energy (EC, 2002; Government Decree 1250/2014, 2014). The possible negative environmental impacts of horse manure can be reduced by controlled manure management (Hadin & Eriksson, 2016). Furthermore, the consistence of horse manure makes it a suitable material for composting and biogas processes (Eronen, Luste, Vanhamäki & Manskinen, 2017).

In the Nordic countries, there is a need for heat production due to cold conditions. Horse manure provides horse farms with possibilities to increase their energy self-sufficiency (Eronen et al., 2017).
The fact that even small farms can utilize this opportunity is promoted through the visualizations presented in this paper.

### 2.2 Visualizing complex and process-based data

Information concerning renewable energy is often complex and troublesome to interpret. It usually includes complicated information on production and consumption sequences which are affected by many variables. This makes it hard for the users to interpret and compare the information. Relative figures connected to other data are needed to provide a fuller picture and, furthermore, to change the mind-set and perspective of consumers. (McCandless, 2010.) Knowledge of the needs of the user group is relevant already in this phase, so that they are taken into account in the analysis (Lipton, 2007).

Energy production and consumption can be seen as processes. Systems-oriented design uses systems thinking and aims to capture the complexity of a system’s models and processes. Systemic approaches could be valuable in design projects. Models can be used to develop a frame that makes it easier to assimilate new information, and also makes it quicker to gain an in-depth understanding of the systems to be designed. (Lurås, Lütżhöft & Sevaldson, 2015.) Data visualization is an important tool for presenting complex information. Ideally, it uses a large amount of information and compresses as well as simplifies it. Static images can be more effective if the information, diction and presentation are designed to be clear and readable. It is often best to simplify as much as you can while fully serving the audience’s needs. On the other hand, it is always best to avoid simplifying to the point of insulting the audience’s intelligence. (Lipton, 2007) Data visualization can also be produced by using linear storytelling and interactive solutions. These enable versatile solutions to present complicated information but can only be used in digital media. However, the production is more time consuming and cumbersome than with static images. The information design process should aim at utilizing the facilities of the selected medium and format, for example utilizing storytelling in an audio visual product, or sorting or presentation methods in an interactive application.

Data wrangling is a process where raw data is sorted and cleaned into a usable form (Figure 1). It is a time-consuming iterative data exploration and transformation process that prepares data for analysis and findings. In-depth sorting and evaluating the usability of the data should be accomplished before starting the analysis (Kendel et al., 2011) There might be a need to go back and look at or collect raw data again when analysing. This new data needs to be wrangled as well. It is possible to begin designing the visualization before data analysis is fully done, but it should not be finalized before all the content is checked and designed. If the specifications for the presentation medium are known, those should also be considered already during the data analysis. (Lipton, 2007.) Data and visualization experts might not have the same opinions when analysing and evaluating the usability of the data. Both aspects have to be fully considered and agreed on before the visualization process starts, in order to make the end product reach the set end goals.
Figure 1. Data wrangling is an iterative data exploration and transformation process which aims to make data more usable for the visualization.

Visualization has been shown to improve learning and recollection, and it can portray complex concepts and relationships more easily than text. Visualizing information in only one dimension is not always the most effective for every user. Multidimensional visualizations enable the integration, manipulation and exploration of dynamic multidimensional data sets. They allow users to not only examine data from new perspectives but also to interact with it more effectively. (Towler, 2015.) For example, users can select the scale, resolution, point of view or data sets that are used when rendering visualization.

In visualizing large amounts of data or complicated processes, also audio-visual and linear narration can be utilized. Narration can adjust the amount of the information that the user has to absorb simultaneously and in that way reduce the cognitive memory load. Memorability can also benefit from the use of narration. People find it easier to remember things that they find interesting. (Adcock, et al, 2006) Using scripting and data analysis it is possible to attach information to natural story elements. The script can, for example, be factual or fictional and it can visualize the selected information through characters or a storyline. People think of incoming information as if they were trying to form stories in order to understand them. (Escalas, 1998; Thompson, 1998.) Our emotions have different plots that are matched to current situations. Dramatic moments in a story awake more emotion than a steady one. Narratives make emotions meaningful by placing them in the context of an individual’s personal history and future-oriented goals. (Escalas, 1998.)
3. Visualization of energy potential

In this study, research on renewable energy was carried out by energy experts. Furthermore, the information was processed and visualized together with design experts and students. This article presents the process of visualizing the study results of energy production on Finnish horse farms.

Based on the research material and guidance from energy experts, information design experts and students from the Institute of Design produced different forms of visualizations from the given data. This interplay between energy experts and designers formed an interesting learning environment. Observations from the process showed that a procedure led by both information design and energy experts is essential for a good visualization outcome.

One group of students worked to create posters based on wrangled data and background information. Energy experts presented the data to the design experts and students through a lecture and discussions. The students had to understand the wider context in order to be able to simplify the data and pick out the core they decided to build the visualization around. They had the possibility to check facts and ideas quickly with the energy experts by email and face-to-face meetings during the contact days. Some misunderstandings having to do with energy-technical issues occurred but they were cleared out during the design process and had hardly any effect on the final products. All facts and ready-made design plans were approved and corrected with the energy experts. Throughout the process, the importance of presenting accurate information was emphasized by the energy experts.

After this stage the students produced graphic design visualization using the information design guidelines. Using the same data set from different points of view, a wide variety of findings and data visualizations were created. One example of a poster is presented in Figure 2.

![Figure 2. Example poster made by a student in media content design, Iiro Piipponen, about biogas production on horse farms.](image)
During the poster design production, the designers found out that all the wrangled energy production data is process-based. These processes are mostly linear chains of events. This led the information design experts to study how animation and storytelling could be utilized in visualization processes.

Hereafter, another group of students used the same data set for creating scripts for informative 2D and 3D animations. As background information, a video from a farm already using the promoted heat recovery technology was also shown. Linear working pipelines are not flexible and animation processes are resource consuming. Information has to be wrangled and analysed in detail before scripting. This kind of an information-based scripting is trying to keep the elements of the story factual but still simplify the form of visualization. Scripting and data wrangling should be co-designed to recognize and achieve common goals during the process.

The manuscript was based on promoting utilization of the heat generated in composting horse manure. Crucial steps of the process were discussed together with energy and design experts as well as the students, and a script was built around them. The jointly built story board defined how the information should be presented and visualized. The role of audio narrative was defined to support the visual world and give the viewer more detailed information about the subject. A storyline made the story easier to follow for the viewer.

Character design for the animation aimed to produce well-designed characters which could also be used later in other visualizations or advertising materials concerning renewable energy. The visual style was created with vector graphics because of its scalability and effective animation tools and pre-sets. All the created assets like characters, equipment and sceneries were made on separate files with clear and cleaned structures. This makes reuse of the assets possible for other designers/students working with the characters in the future.

The main characters were built and rigged over “a skeleton” that enables a fast animation process (Figure 3). The animated skeleton can also be reloaded with new graphics if needed. Animation project files were cleaned, organized and guided for later use. In this way, separate animation assets are easy and fast to produce for different visualizations. For example, animated compost machinery can be rendered in a different colour, speed or resolution for an interactive application or a PowerPoint presentation. As a result of the process, an animation lasting 5:40 minutes was produced.

The production was based on creating better tools and pre-sets for the project and improving the production economy. Visualizations produced in the project and the collected information need to be in a form which enables other designers to work with them in the future. The message used can be designed better after collecting and analysing experiences and feedback. This cost-effective animation project model enables a more exact product analysis between different animation versions. For example, different characters can be rendered for the same animations or new parts added to the storyline.
4. Conclusions

In this study, simple and comparable information about renewable energy potential of rural areas was produced through visualization in order to encourage rural actors to consume renewable energy and also invest in the production of it. Information design was shown to be a practical tool in visualizing complex energy data to a consumer-friendly format, which supports the utilization of renewable energy, and, by doing so, also enhances the circular economy.

The information design process done together with energy and design experts can lead to an effective production model. This multidisciplinary process will produce more reliable, useful and informative visualizations. However, during the process it was found out that the data presented should be strictly limited in order to focus on the most important issues and not to confuse the designers. Furthermore, it was crucial to point out that a nice-looking poster with incorrect information cannot be used in promoting information. The process showed that information design and data visualizations can be a lot more than still images or illustrations. Bringing experts from the fields of storytelling, motion understanding and computer-generated graphics gives the production of data visualization new and interesting creative possibilities. Moreover, complex data becomes more informative to the customer. If the aim is to communicate complex system- and process-based information, storyline-based visualizations are efficient and show promising potential in delivering the kind of systemic information that renewable energy production represents.
The study showed that the data visualization process for posters and other graphical visualizations differs from linear story-based visualizations such as animations. Information design for story-based visualization and wrangling should focus on finding a complete line of information in order to make the story comprehensive. Information-based script writing can utilize storytelling for making the message clearer, more memorable or understandable. For example, the most important information can be written into the highlights of the story, to give it more weight. Energy production and consumption processes are well suited for story-based information design.

This study has given a lot of useful experience about how to develop and improve data visualizations based on renewable energy information. However, several ways to improve and diversify visualizations remain to be tested. For instance, the cooperation process between the energy and design experts can be developed to be closer and smoother. The next steps are planned to include collecting feedback from the target group and comparing the usefulness of different visualization formats in practice. Feedback will be analyzed and utilized when producing further visualizations.

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