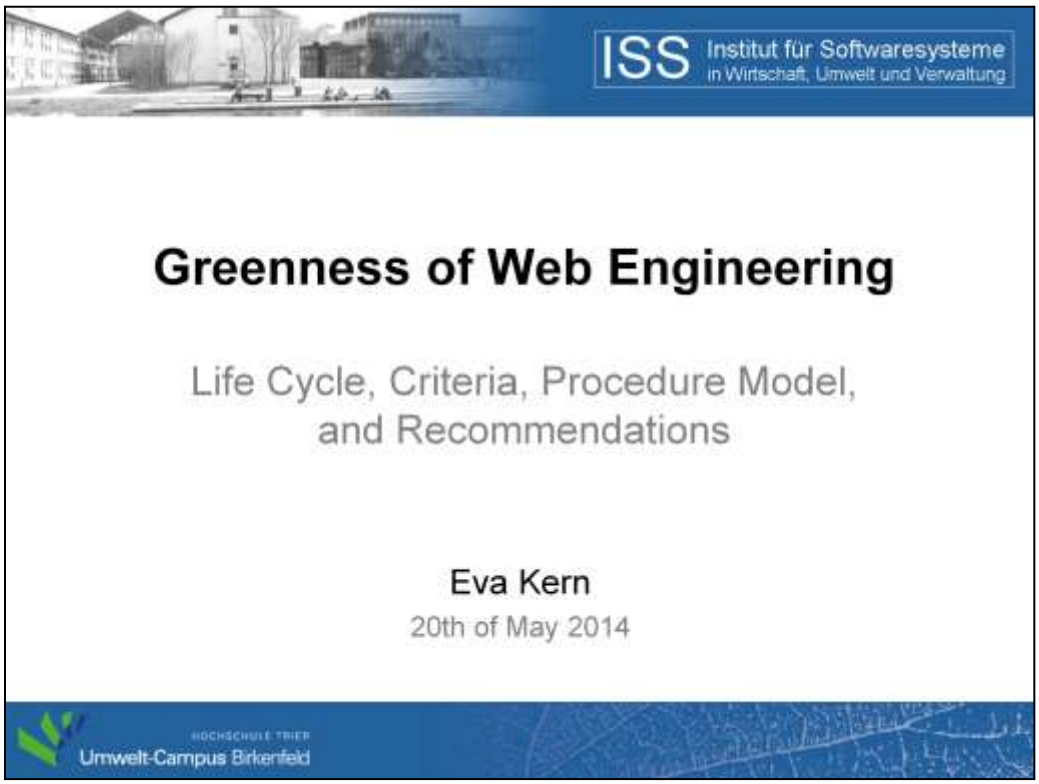
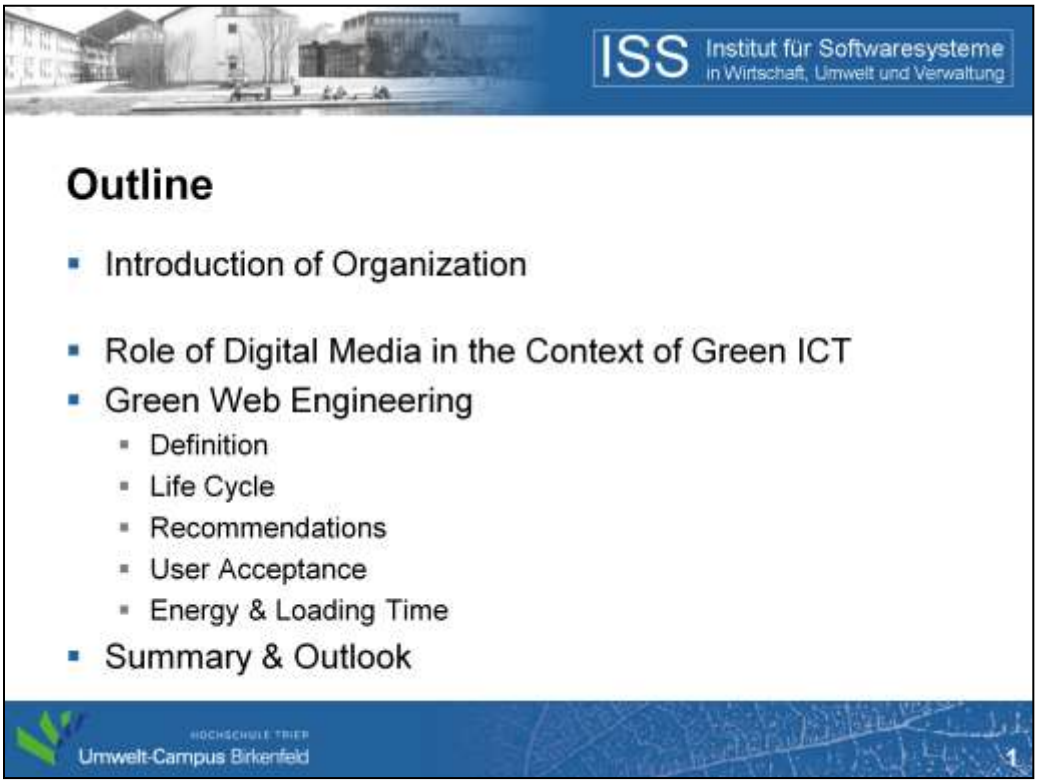

ISS
Institut für Softwaresysteme
in Wirtschaft, Umwelt und Verwaltung
Greenness of Web Engineering
Life Cycle, Criteria, Procedure Model,
and Recommendations
Eva Kern
20th of May 2014
HOCHSCHULE TRIER
Umwelt-Campus Birkenfeld



Before I will start with the topic „Greenness of Web Engineering “ in detail, I will give you a short introduction of my organization. In that way you will get an impression what we are doing here next to the Green IT activities.

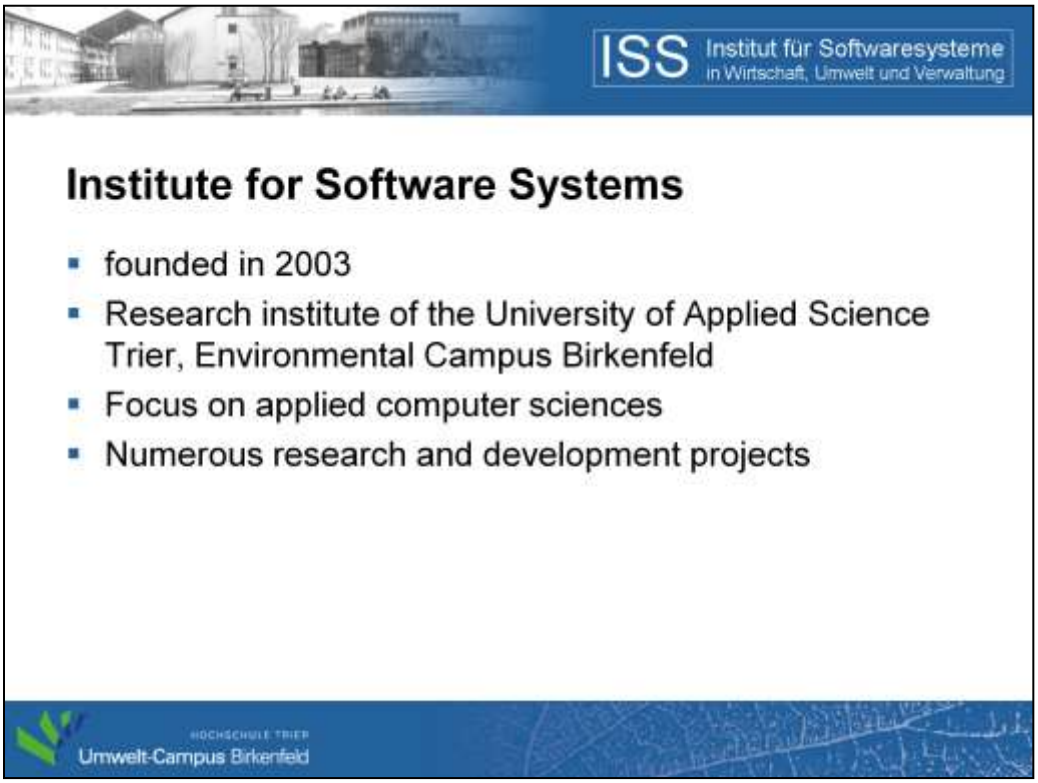
Afterwards, I will point out the role of digital media in the context of green ICT.

One of the well know media is the world wide web. In our research project – called GREENSOFT – we had a look onto the green web engineering.

So, I will tell you, what we do understand as „Green Web Engineering“, will introduce the life cycle of a website to you and tell you how to apply principles of green web engineering.

Additionally, I will go into the user acceptance, energy measurements and loading time in this context.

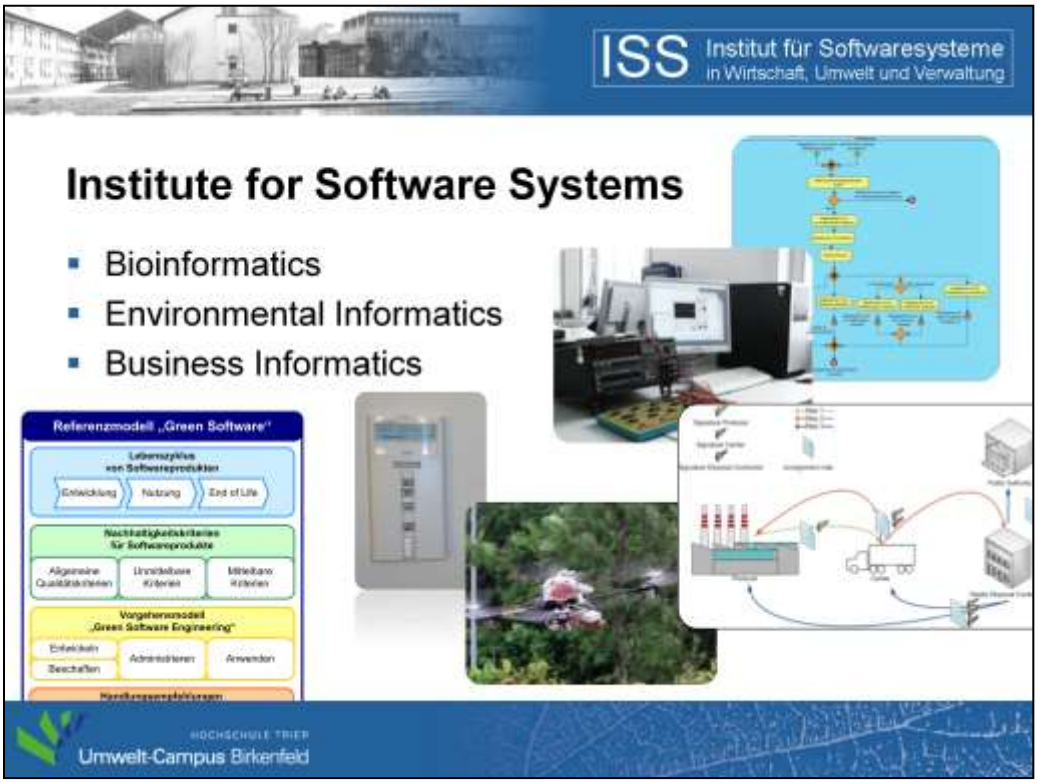
In the end, I will give a short summary and outlook.



The Institute for Software Systems was founded in 2003 as research department of the University of Applied Science Trier. It is an academic research institute based at the Environmental Campus Birkenfeld.

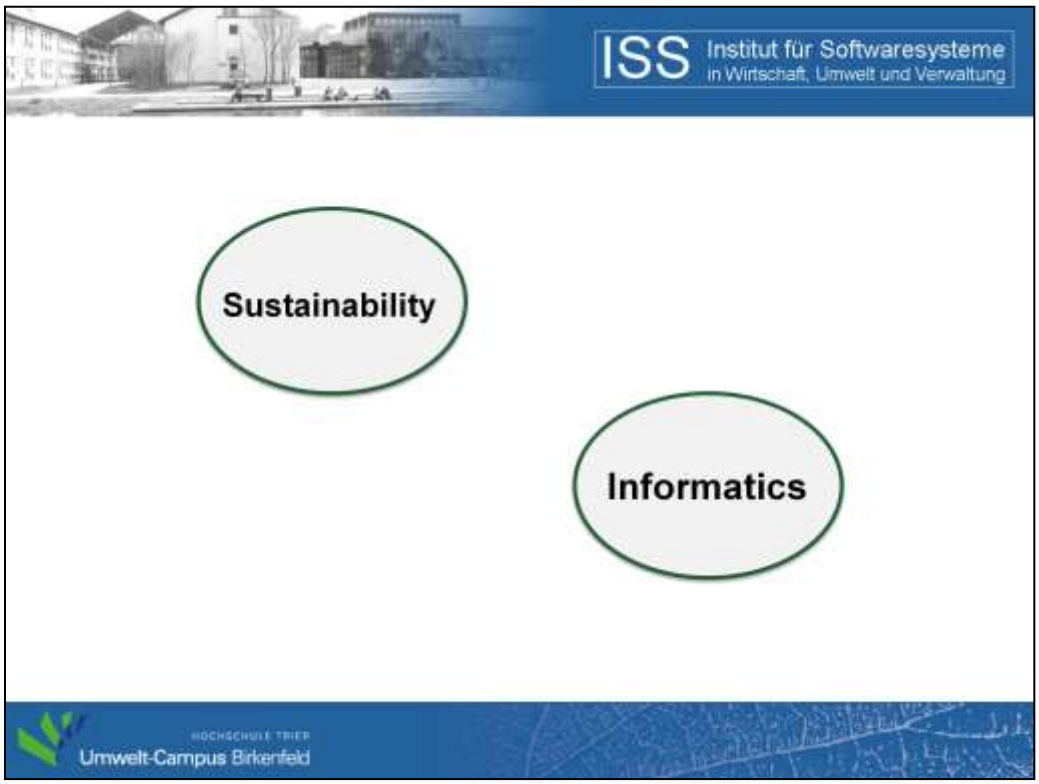
The focus is on applied computer sciences, where numerous R&D projects were realized in close cooperation with companies and public authorities. The projects are financed through support programs or external clients

The members of the institute draw upon many years of experience and profound knowledge in managing and realizing R&D projects in applied computer sciences. They provide competent support and cooperation for application oriented research.



Our projects are in the context of bioinformatics, environmental informatics and business informatics.

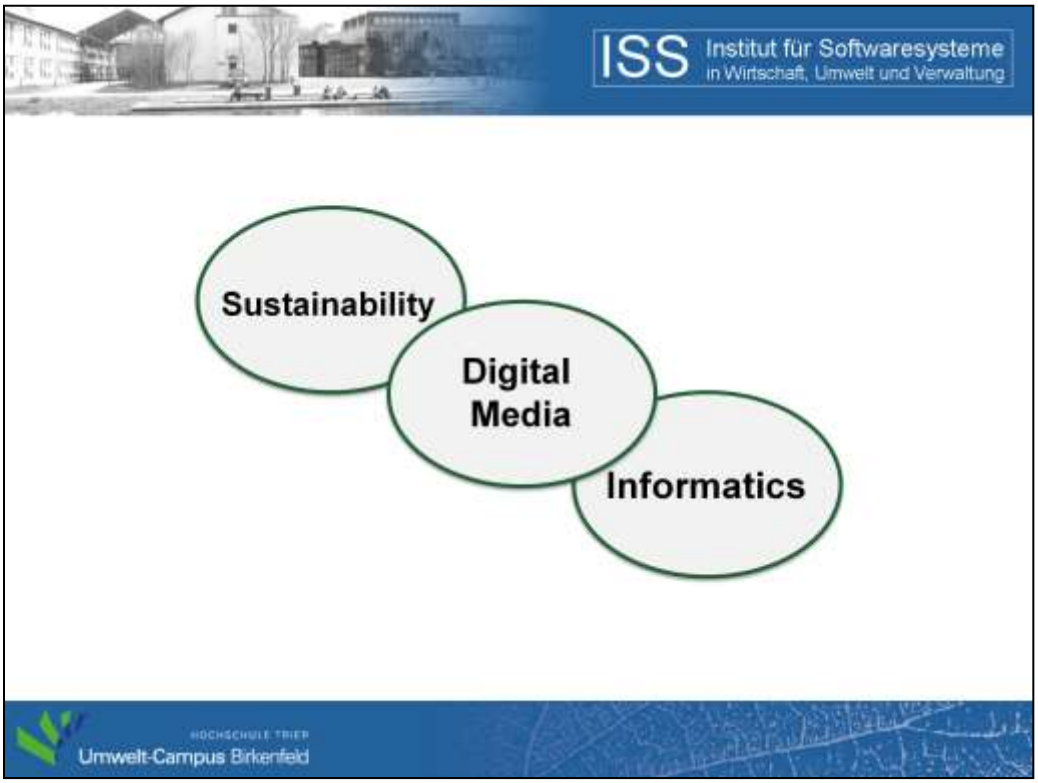
The pictures give you an impression of different research projects here.



The topic of this year „Green Week“ or rather of the webinar is „Green IT“. So, I‘m quite sure you know the meaning of it.

In our research project we always had a look onto more than Green Software, but rather sustainable software. So here, means in the context of sustainability and informatics, approaches, definitions, measurement, ideas, criteria exist.

That‘s why I asked myself… What‘s about media?



The questions that arises for myself have been:

- What is the role of digital media in the context of sustainability informatics?
- Do media have a positive or rather a negative role?
- Are they consuming energy and resources in general?
- ….

I came to the conclusion that the role of digital media in the context of Green IT is positive as well as negative.

On the one hand, they can support the activities for a sustainable development.

For example, it is possible to communicate about environmental topics by the help of media. They also give more transparency, e.g. by demonstrating solutions and so on. Media are a possibility to support activities around the environment. This is the same for information about Green IT, sustainable aspects, solutions to save the environment and so on.

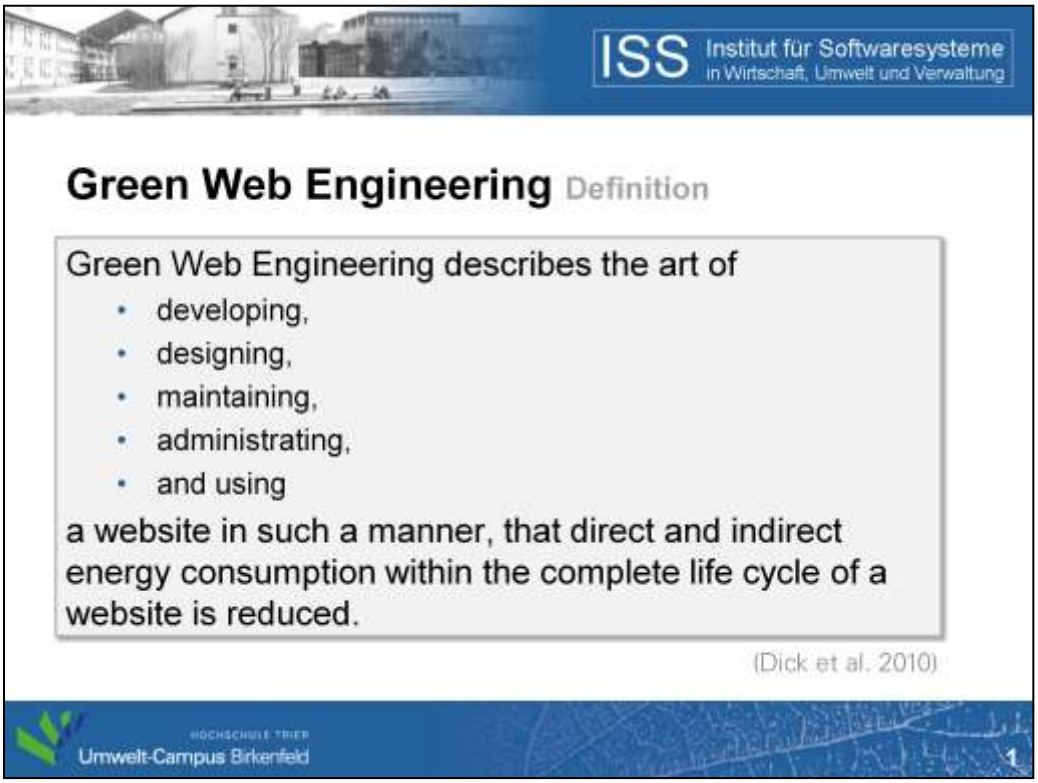
On the other hand, media consume energy and resources as soon as they exist. They need to be produces and supplied. Just imagine – how to use the medium Internet without having a computer, tablet, smartphone or whatever? Not possible. And of course we all know that we consume energy while we are using media, we are also consuming the resources itself.

While, similar to Green IT, the fist part – the „friendly part“ of media can be called „green by media“, in the other context, there need to be activities to be more green in media.

This second part will be the topic of my presentation today.

That means: Are there possibilities to make media „greener“?

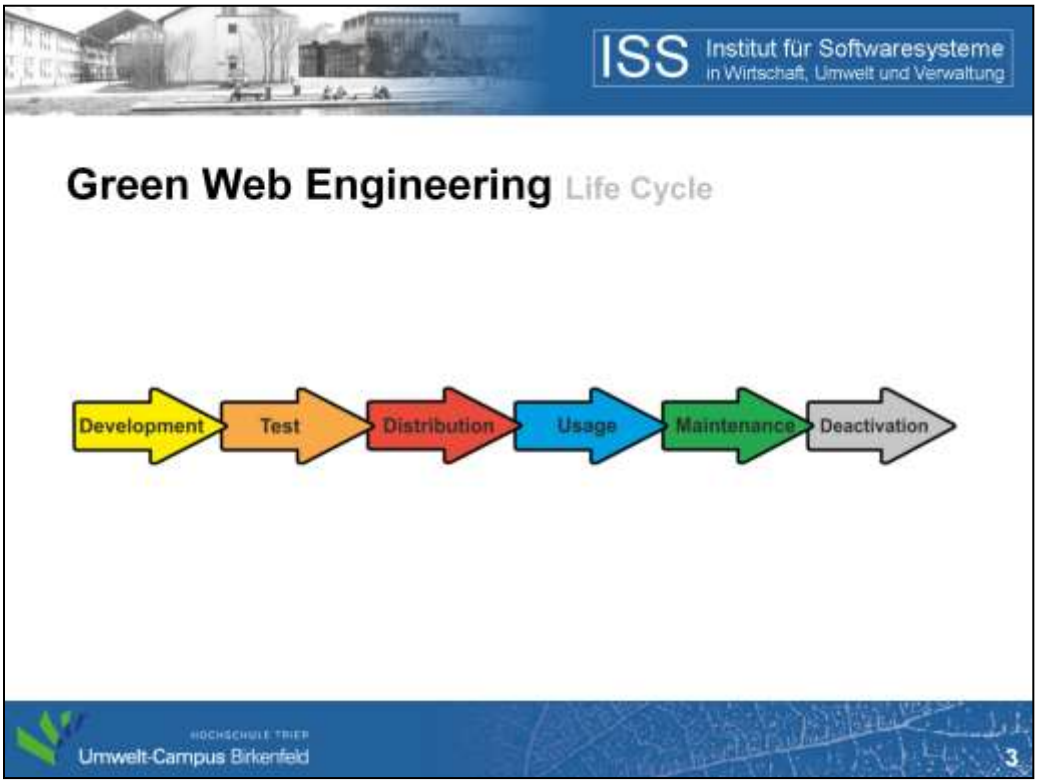
In order to find possible answers to this question, I will concentrate on the medium web.



So, first of all – what do we understand by Green Web Engineering?

Green Web Engineering …

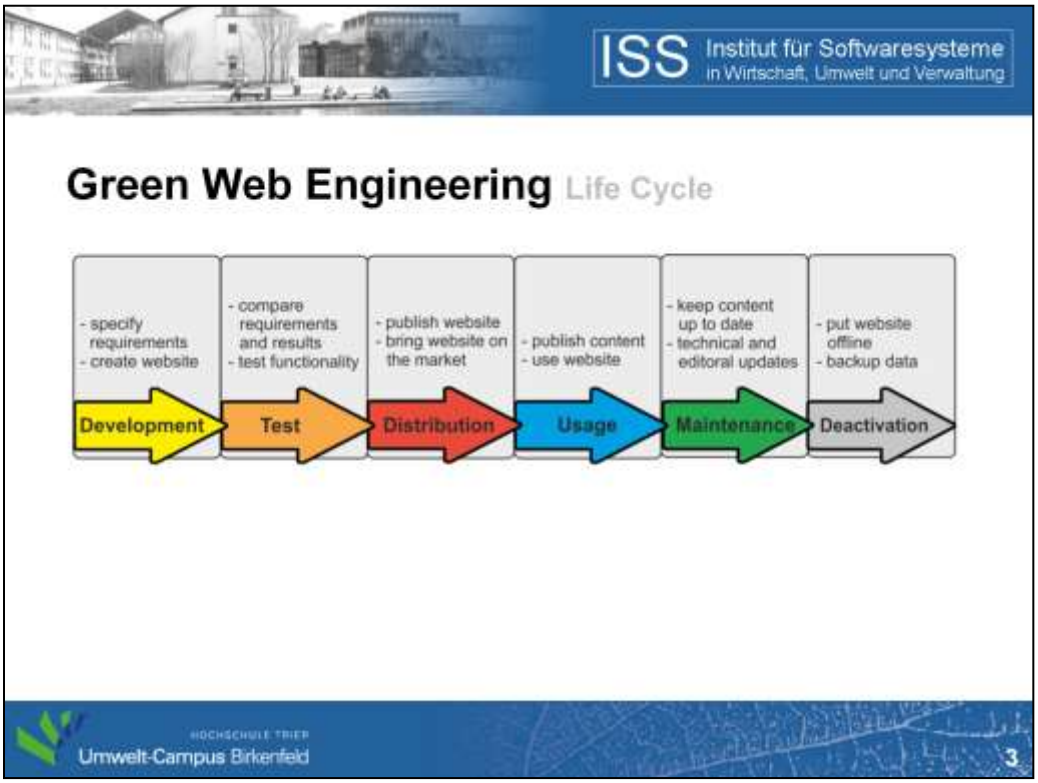
Short form: try to reduce the energy consumption of a website from its beginning to the end!



What does that mean? From the beginning to the end?

Thinking about different phases of a website it is possible to create a life cycle of websites

Here, the phases are: development, test, distribution, usage, maintenance, deactivation.



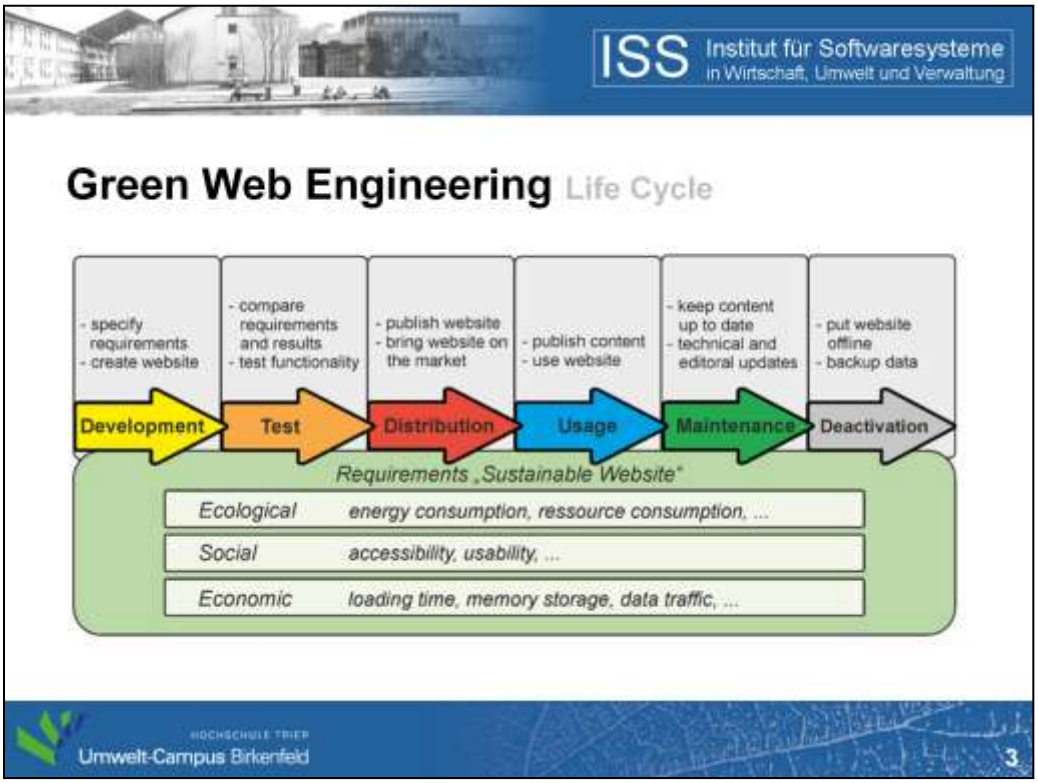
The different phases of the life cycle of a website are described by the tasks of a web engineer.

Here, the tasks are just listed exemplarily in order to give an impression of the specific phase. The detailed steps on how to develop, run, and deactivate a website are not complete and thus expandable

For example, during the test phase, the requirements and the results of the development are compared.

…

So far, the „green“ or even the „sustainable“ aspect of a website is not included in the life cycle.



That means (in my opinion) there need to be requirements for a „sustainable website".

Sustainability consists of the three pillars: environment, economy and social aspects.

The exact criteria need to be detailed, so far there are actually no criteria what a green website or even a sustainable website is. The research is still on it.

Indeed, I think some requirements – that could be pointed out as criteria – are quite clear (or even known from other contexts):

- The environment is addressed by energy consumption and resource consumption
- Social aspects are for example the accessibility and usability of a website. Is everyone able to use the website and all of its functionality? Is it easy and learnable to use it?
- And the last point, economic requirements, are for example the loading time, the memory storage and data traffic. Most of them do influence the costs a website causes during its life cycle

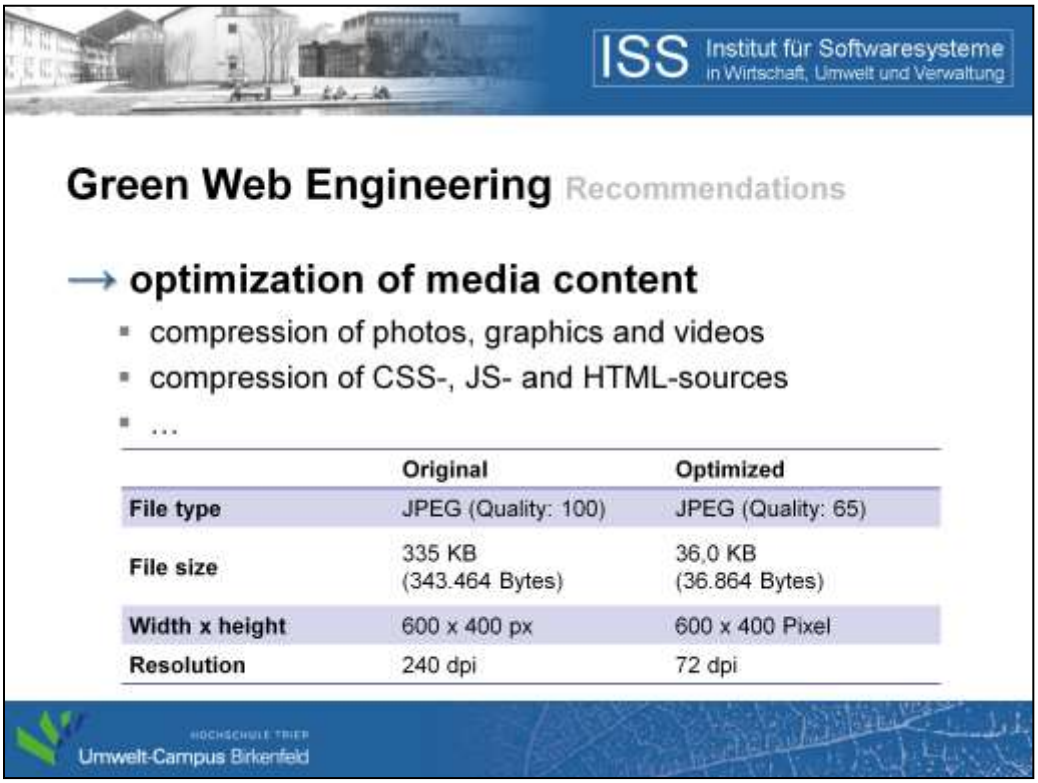
(Comparison of a non-optimized (left) and an optimized photo (right))

After this theoretical basics let me come to a more practical part. How can we apply Green Web Engineering?

One possibility is to optimize the media content.

In order to reduce the memory space or probably the energy consumption to download content in the Internet, one can compress photos, graphics, videos, but also the source code (like cascading style sheets, java script and html)

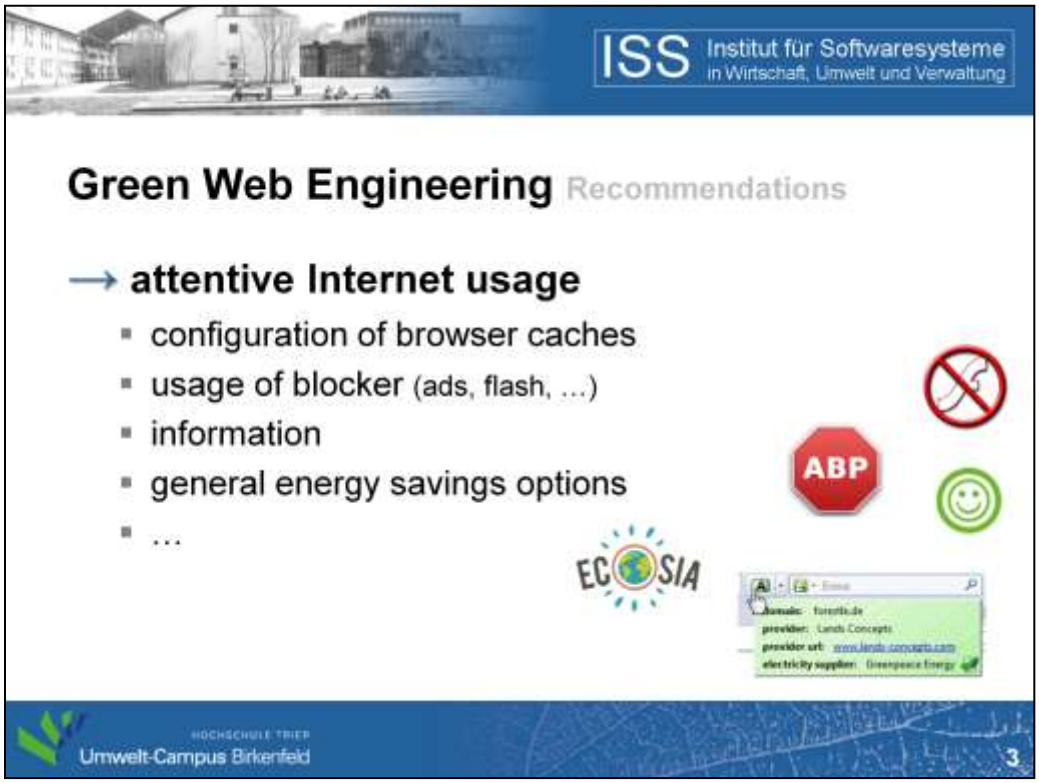
On the slide you can see two photos – do you see a difference?



There is a difference if you compare the file size: as you can see the optimized one is smaller than the original one. Why? The quality as well as the resolution is reduced by using software.

We did so in order to find out if the energy consumption while loading smaller images is getting down. I will come to the results of the measurements later.

For now, let me go on with recommendations….



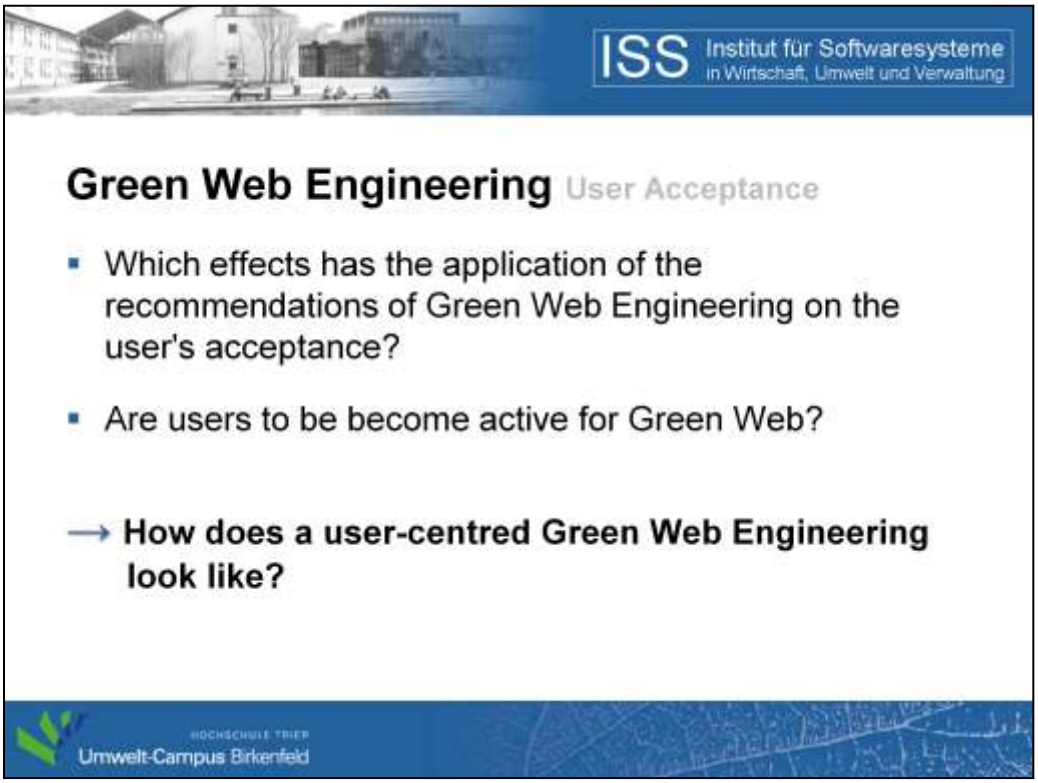
What can the user do? It is not only the web engineer who can be active.

A user can for example use browser caches to prevent unnecessary downloads. It is the same effect by using blocker for ads or stuff like that – content that is in general not needed but consumes energy.

Furthermore, the user can inform themselves about the topic.

And of course there are general advices like using the energy saving options of your computer.

Okay, here are principles – but I wondered if there is a acceptance for that by the user.



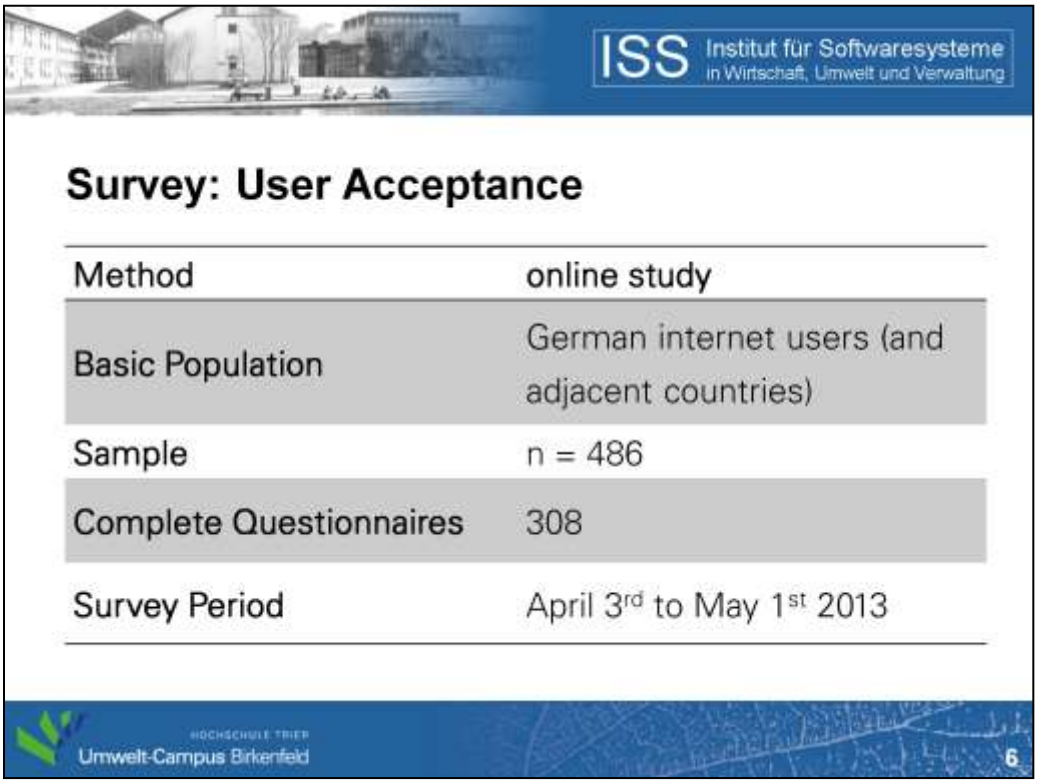
User acceptance is very important in the WWW.

Hence, in order to optimize a website regarding its energy and resource efficiency, it is interesting to know if the resulting effects are accepted by the user. Only if the result of the optimization is accepted by the potential users, the actions are promising in the long run.

In order to find out the user acceptance for green web engineering, I conducted a survey. The media content has been optimized in different ways and strength before publishing it on a website. Afterwards, the user is asked for their acceptance.

Especially media content (photos, graphics) that shows differences in file sizes and image qualities has been chosen.

Above that, the users have been asked about their willingness to be active for a sustainable Internet.



Just some meta information about the survey:

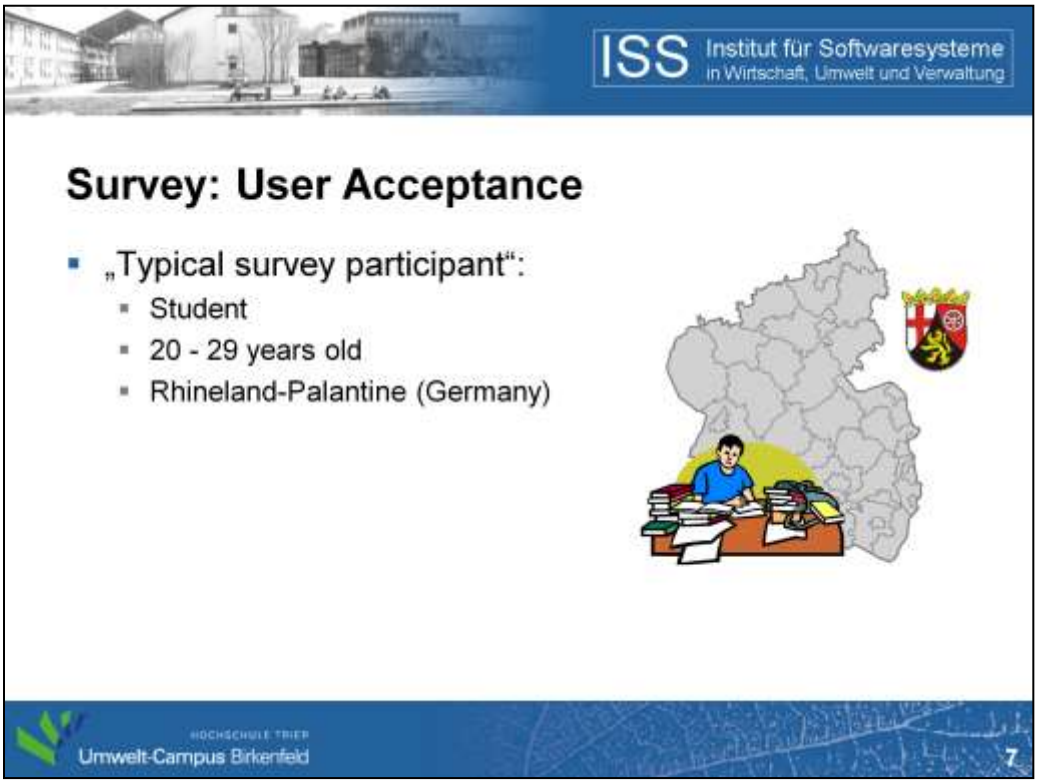
The german internet users have been adressed and I reached three hundred and eight complete questionaries. The survey has been applied about one year ago.

Die Geschlechterverteilung der Teilnehmenden an der Umfrage ist mit 45,13 % Teilnehmerinnen und 54,87 % Teilnehmern relativ ausgeglichen. Diese Personen sind überwiegend Vollzeit-Studierende (61,04 %) aus Rheinland-Pfalz (43,51 %) im Alter von 20 bis 29 Jahren (71,10 %). Es handelt sich daher nicht um eine für die Gesamtheit der Internetnutzer repräsentative Stichprobe, dennoch vermitteln die Ergebnisse einen guten Eindruck zur Akzeptanz und Aktivität im Green Web.

Bereits aktiv sind die befragten Personen in der Nutzung von verschiedenen Blockern (weitere Details dazu in Abschnitt 6.3.1). Hinsichtlich der vorgenommenen Einstellungen verhält es sich wie folgt: Die Browsereinstellungen zur Blockierung von Popup-Fenstern haben 69,16 % geändert. Bezogen auf die Änderung der JS-Aktivierung halten sich die Ja-

(42,53 %) und Nein-Antworten (43,18 %, Rest: „weiß nicht“) etwa die Waage. An den Einstellungen zum Laden von Grafiken haben nur 19,81 % der Nutzer etwas geändert.

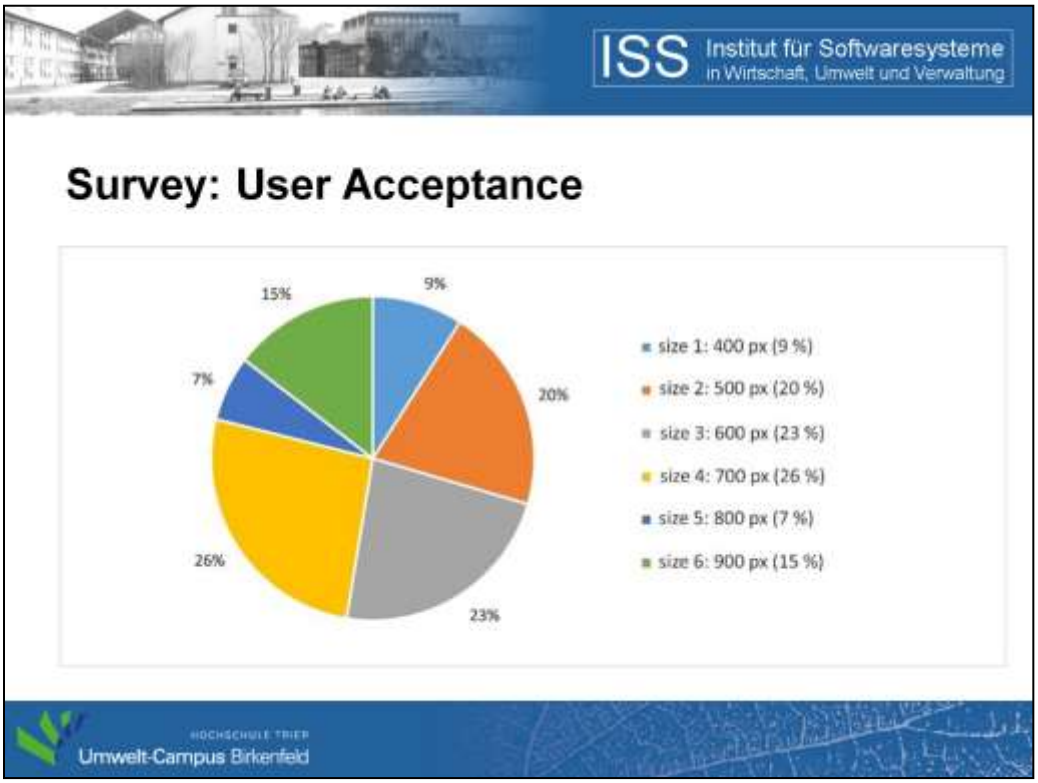
Eine Kennzeichnung von nachhaltigen Websites können sich die befragten Nutzer am ehesten über ein standardisiertes Label mit festen Kriterien vorstellen (55,52 %), welches in Form einer „Ampel“ (Energieeffizienzklasse) gestaltet ist. Vergeben werden sollte dies, nach Meinung der Umfrageteilnehmer, von unabhängigen Organisationen.



Since, most of the participants of the survey are students (20 to 29 years old) from the federal state Rhineland-Palatinate (Germany) the random sample is not representative for the total Internet users. However, the results do give an impression of the acceptance and activity of users for a green web.

Overall, based on the results, the respondents have a positive attitude towards renewable energies, Green IT, and further ecological important aspects, e.g. most of them are using the energy management of their computers (81.83 %) and advocate fair trade (78.89 %). A life without media or the Internet is hard to imagine for most of them (73.05 %). Regarding the Internet usage, using search engines (98.05 %) and e-mails (97.40 %) are most important. Altogether, the answers of the participants show that they are interested in the field of sustainability as well as in societal and political topics and have a strong affinity to media.

The results, that will be presented in detail in a bit, show that there is an acceptance for a so called “Green Web” and the users are already active in this context.



Just to give you an example…. Here you can see the detailed results of my questions about the agreeable sizes for photos.

I think that it is interesting that the photo does not need to be that huge. The middle way should be the solution.

Summarizing, the results of the survey, a user-centered Green Web Engineering could be look like this.

One idea is to label green websites, to create awareness and transparency.

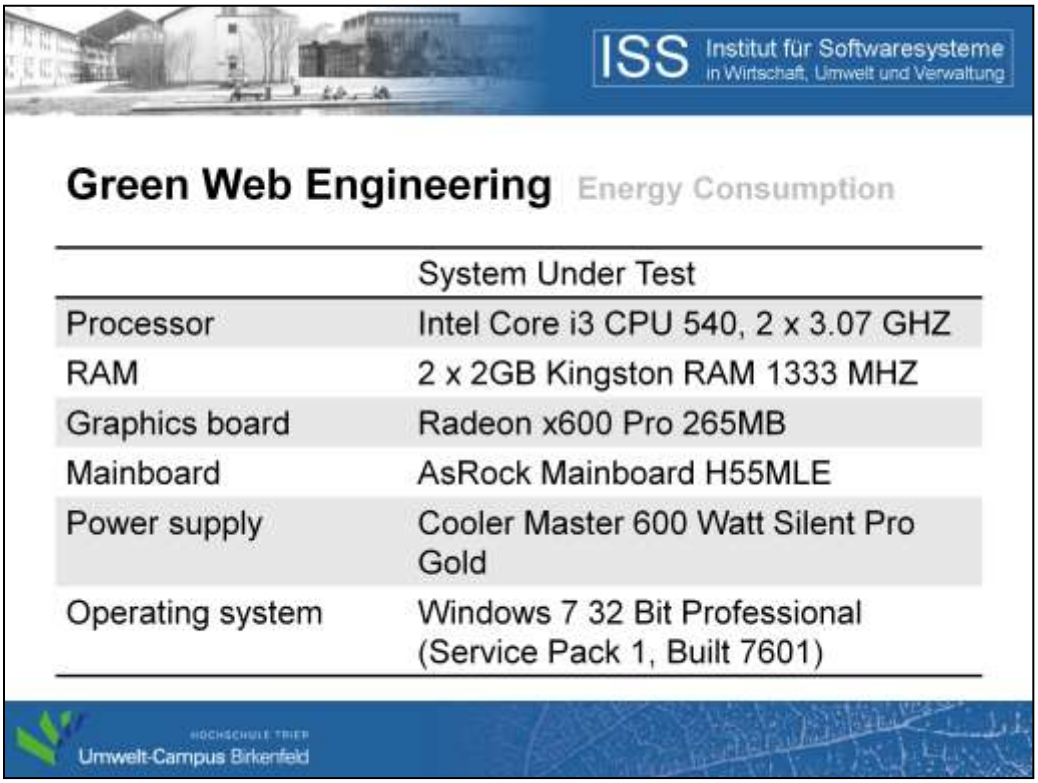
It could be possible to develop a Label in the form of a traffic light – like colored quality classes: green (good), yellow and red.

A next step is to optimize and compress source code. No user will recognize that, they can‘t see it.

And then to become even better, do the same with graphics. Here it is important to keep the given information!

And as shown before for sizes of pictures, static as well as videos, a smaller size is also okay.

- for photos: From 600 to 700px (the longest picture page)
- for videos: 640 x 480px



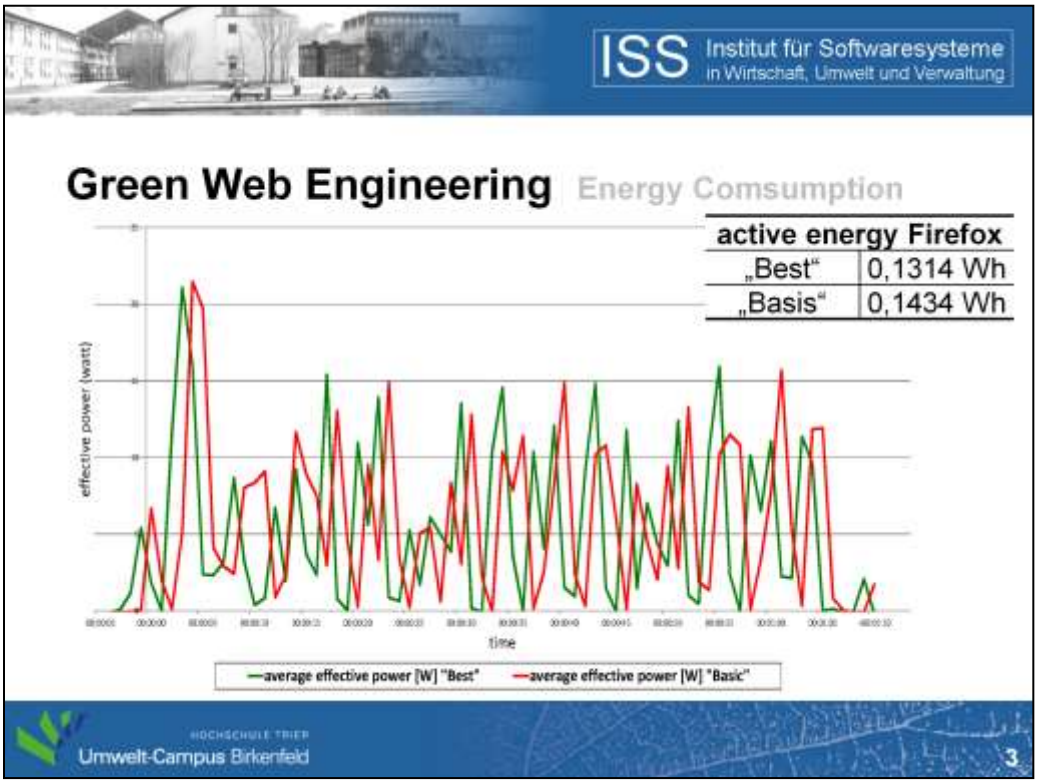
Next to the user acceptance, I wanted to know if applying the recommendations does lead to less energy consumption. To do so I used the following system under test: …

On the slide you can see the specification of the System Under Test (SUT).

The test setup: The Workload Generator applies the workload to the SUT. In this case, the scenarios are directly executed on the SUT while the induced energy consumption is measured by the Power Meter. The Data Aggregator and Evaluator collects the results from the SUT, the energy readings, and the workload statistics.

The measurement scenarios were laid out for a 1:10 minutes test run. Based on the website versions – showed on the slide - , the scenarios focused on different kind of contents (photos, graphics, css and js).

The browser used, that means the software executed on the SUT, was Firefox.



And this is one of the results – you can see two graphs.

For the red line it is the basic scenario, that means no principles of green web engineering have been applied.

Overall, the Firefox used less energy if the media content as well as source code is optimized and compressed before bringing it onto the website.

Conclusion & Outlook

- Media do play a role in the context of Green ICT
- User's acceptance & activites for Green Web exist
- Optimisation wears positive effects on the energy consumption

- Optimisation & spreading of the action recommendations
- Development of suitable tools

If you have further ideas or suggestions on how to improve the measurement and rating method,

feel free to contact us at the Environmental Campus Birkenfeld of the Trier University of Applied Sciences in Germany.

Thank you very much for your time and attention.