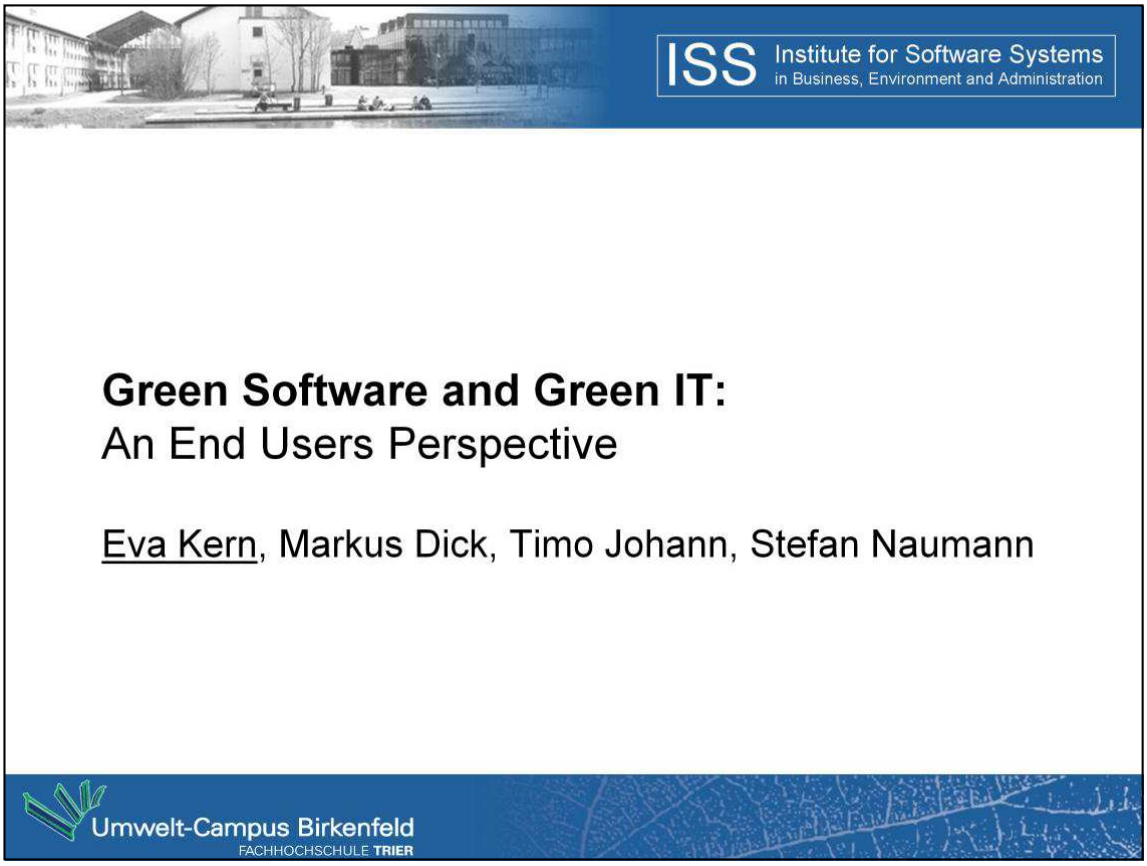

Eva Kern, Markus Dick, Timo Johann, Stefan Naumann
{e.kern, m.dick, t.johann, s.naumann}(at)umwelt-campus.de

Trier University of Applied Sciences, Umwelt-Campus Birkenfeld
Campusallee, D-55768 Hoppstädten-Weiersbach, Germany

http://www.green-software-engineering.de/

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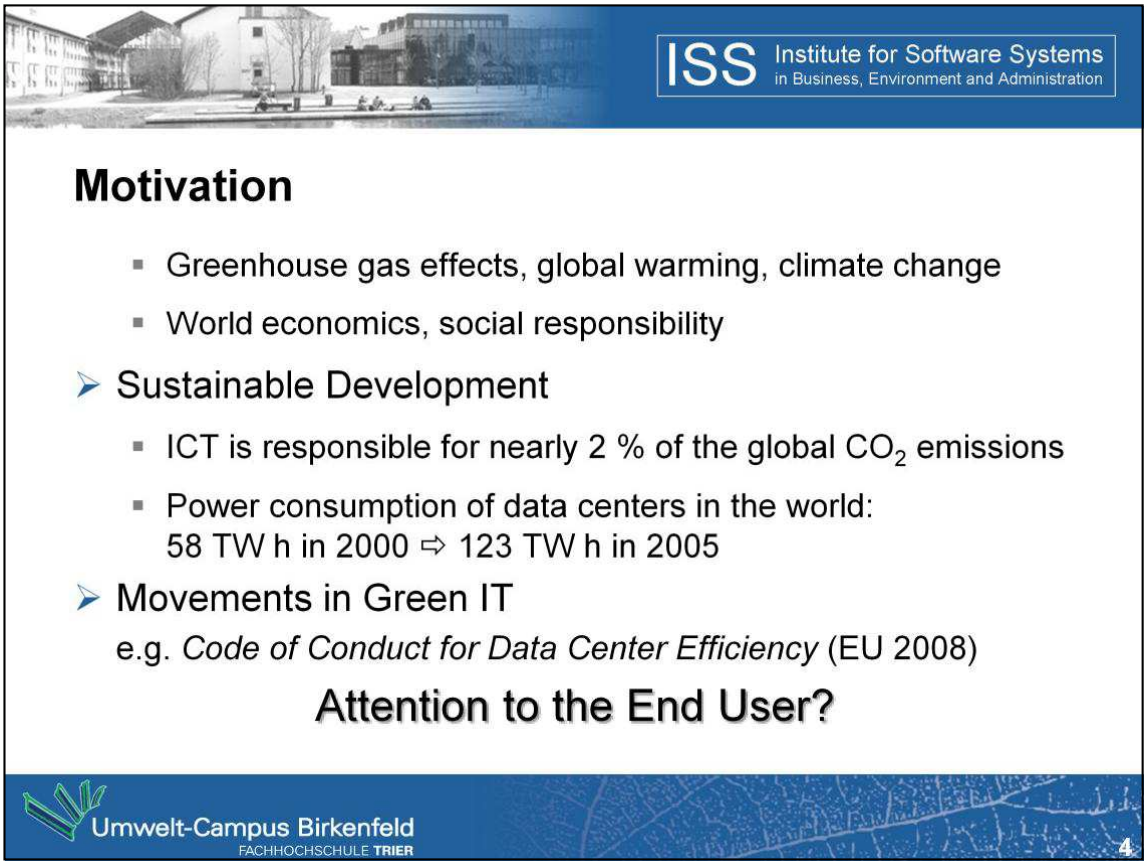
Outline

I. Motivation

II. Typical End User Scenarios
   a. Testing of Software Selection and Configuration
   b. Results
   c. End Users Advices

III. Summary & Outlook

I. Motivation



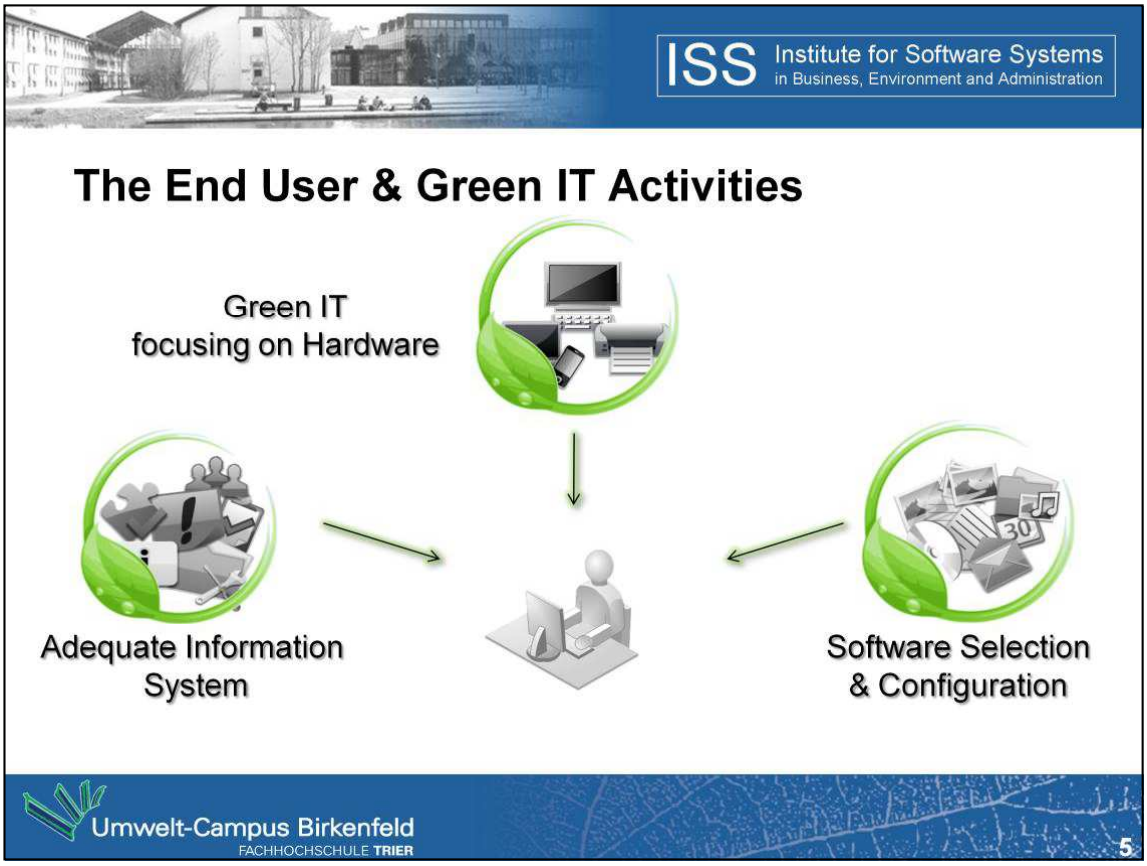
The key challenges of our century are greenhouse gas effects, global warming and climate change.
And there is more, sustainability is also related to the world economic and social responsibility.

All in all, that is reason enough for changing to a sustainable development in a way as described in the Brundland report.
Sustainable Development means to try to meet the needs of the present without compromising the chances of future generations to meet their own needs.

The discussion of a sustainable way of live if also becoming more and more interesting for the IT sector.
This stands to reason since the ICT industry is responsible for nearly two percent of the CO_2 emissions worldwide.
To quantify this: The power consumption of data centers in the world increased from 58 TW h in 2000 to 123 TW h in 2005, and is still increasing.

As you can see with the Code of Conduct for Data Center Efficiency, the EU published in 2008, there are movements in Green IT.

Indeed, they do not pay much intention to the end user itself.



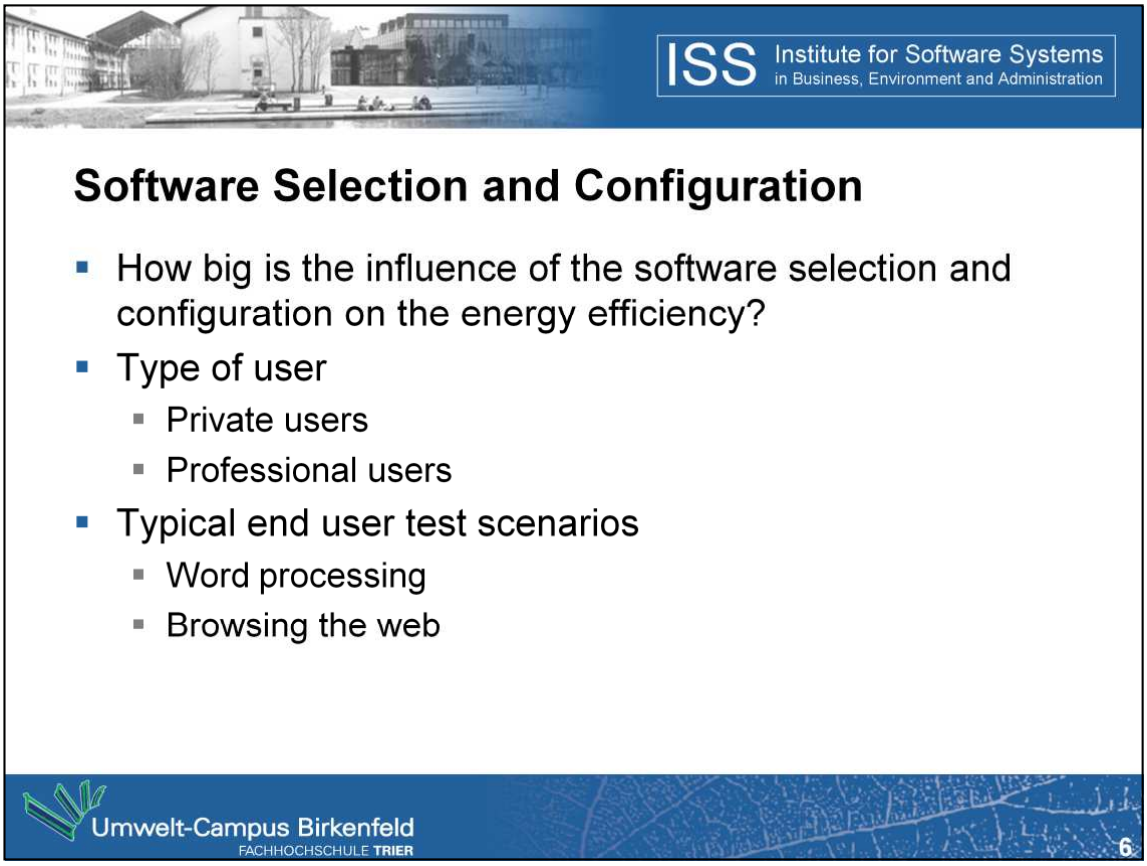
There are three aspects of the relation between end users and Green IT activities:

First of all, the hardware side: Thinking of Green IT mostly advices like using energy-saving modes or printing duplex come to mind. This is the field most of the users are quite common with. Many checklists are available and the industry is promoting green hardware more and more.

Another aspect is the software. The user is independent in his choice of IT tools and software. Even thought the energy management of the operating system is probably the predominant driver for the resulting energy consumption, we think that the software side also influences the carbon footprint of the IT. To get an impression of the dimensions we set up some test scenarios, which will be described later.

The third aspect are information systems for the end user. The users need to be aware that there is for example more than just one software-option to choose. It is important to draw their attention to the influence they can have! We think, only if they know the score of their influence, they might think about joining the movements to greener ICT.

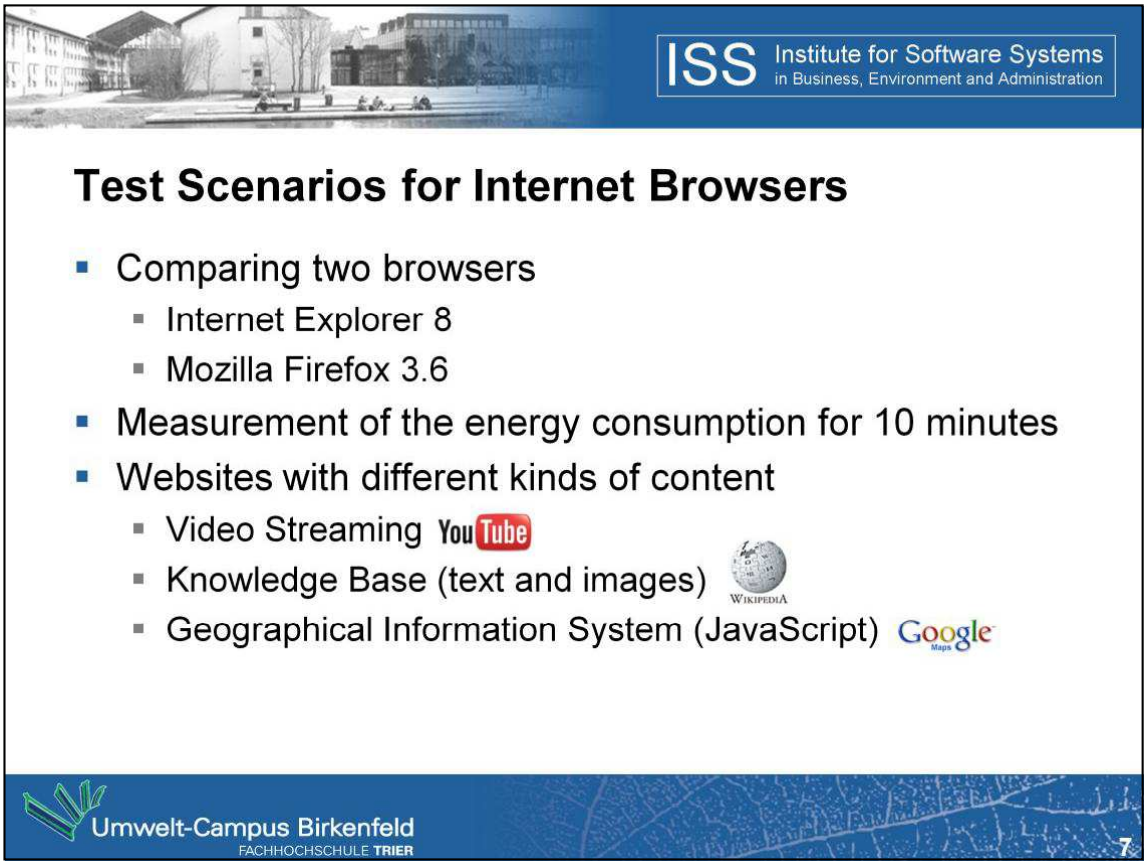
We focus on the software side, because as far as we know there exist only a few advices for selecting, using, configuring software products. Green IT mostly focused on the hardware side.



To find out how much users can directly reduce their energy consumed by IT, we defined and tested typical end user scenarios.

In this context “end user” does not only include the private user at home but also business users, since the topic is also interesting for companies.
The agreement of Green IT influences the environmental report and carbon footprint of a company, which is getting more and more important in economics.

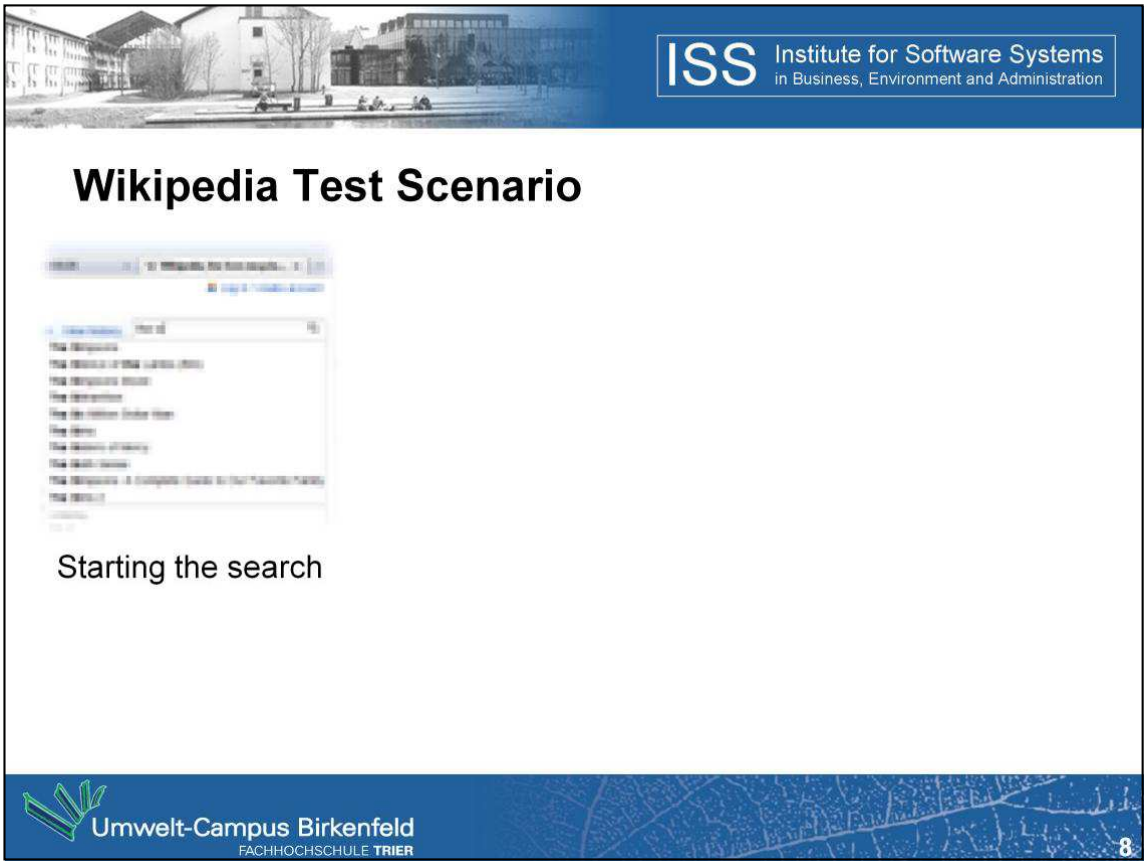
Statistics show that the private user (but also the business user) uses the PC mainly for word processing, browsing the web and communication.
Hence we set up test scenarios for two word processor application, namely Microsoft Office Word and Open Office Writer.
We defined actions which were performed while the measurements are being taken. These actions include typing text, formatting the document, adding an image, saving and printing the document.
The results show differences in the resulting power consumption of the two software tools.



Furthermore we tested two different internet browsers. We compared the Internet Explorer 8 and Mozilla Firefox 3.6.

To do so, we set up test scenarios to take measures of the energy consumption of different end user's applications.
All scenarios are laid out for a 10 minutes test run.
We used an automation tool to be able to repeat the tests as often as needed.

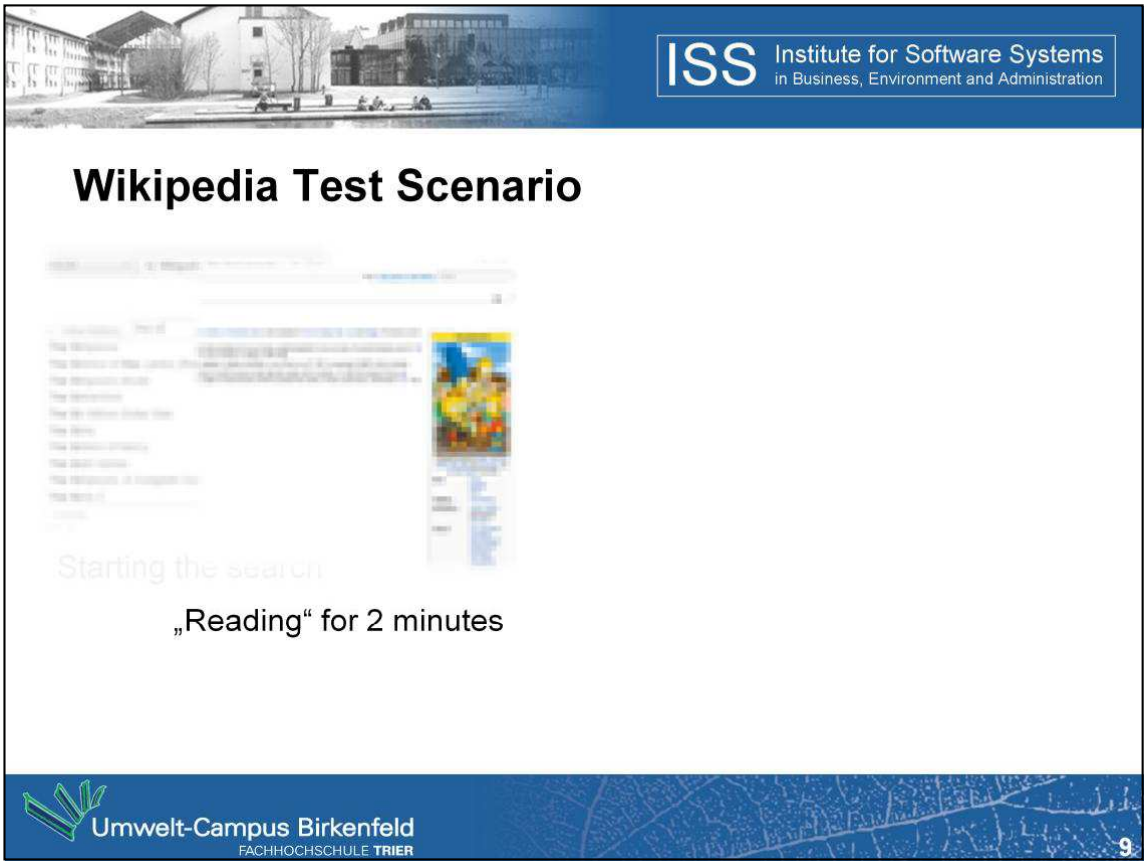
Since the energy consumption is related to the shown content of a website we chose websites with three different kinds of content:
- One video streaming website
- one knowledge base with simple text and images as content
- and one geographical information system which is realized with JavaScript



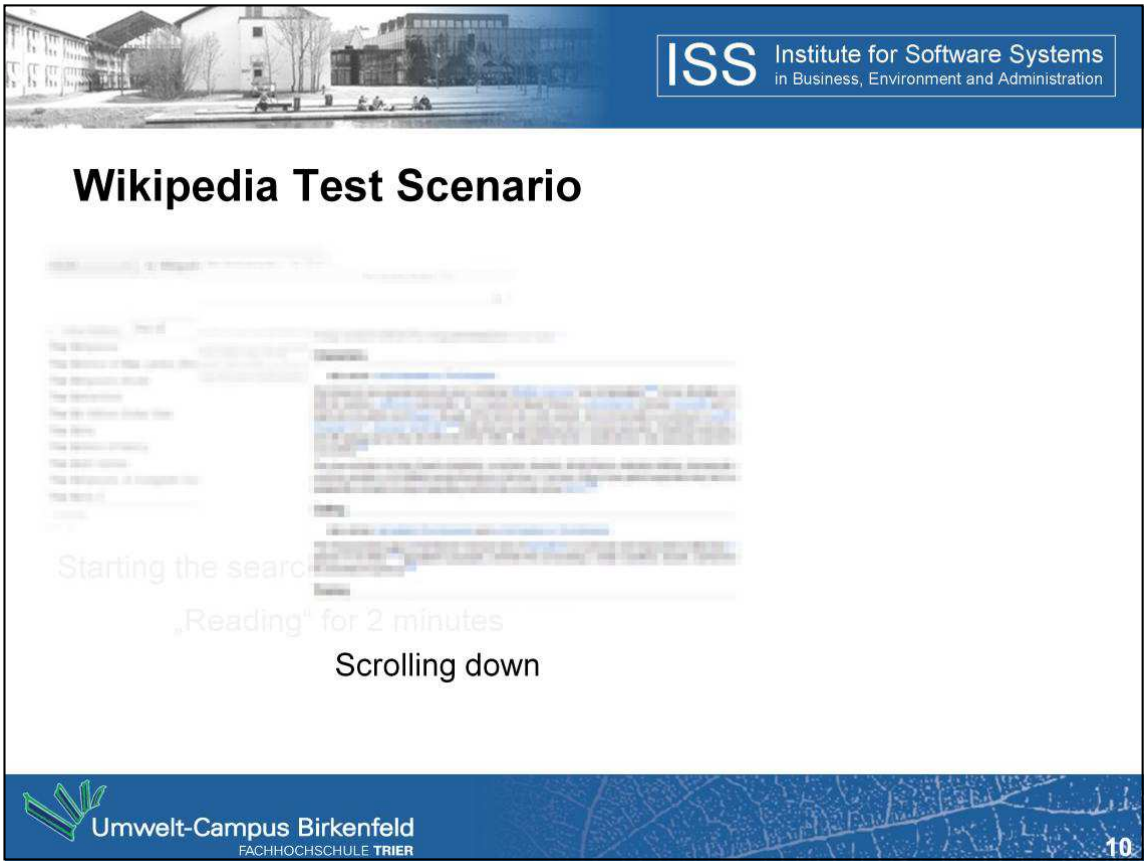
To test the energy consumption of the knowledge base website we set up the following test scenario:

During the measurements a search of a specific article is simulated.

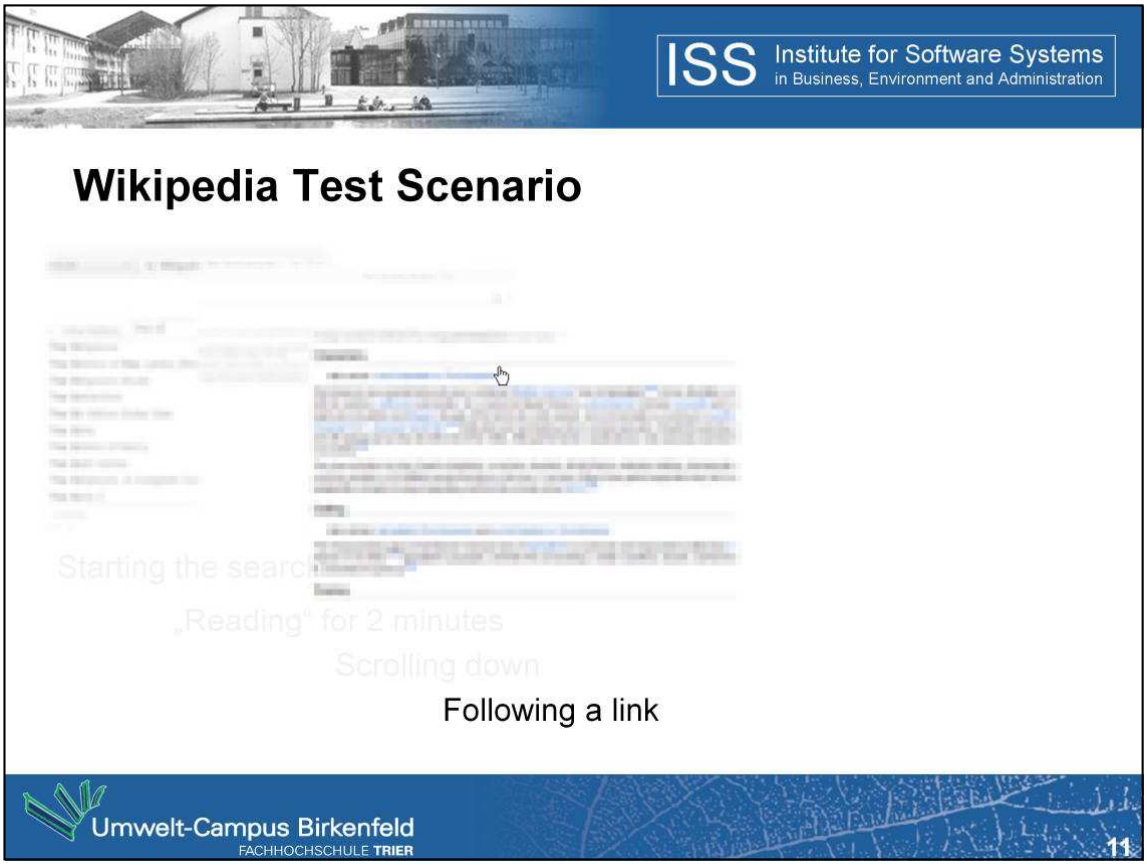
First, starting the search on Wikipedia by typing in the keyword.



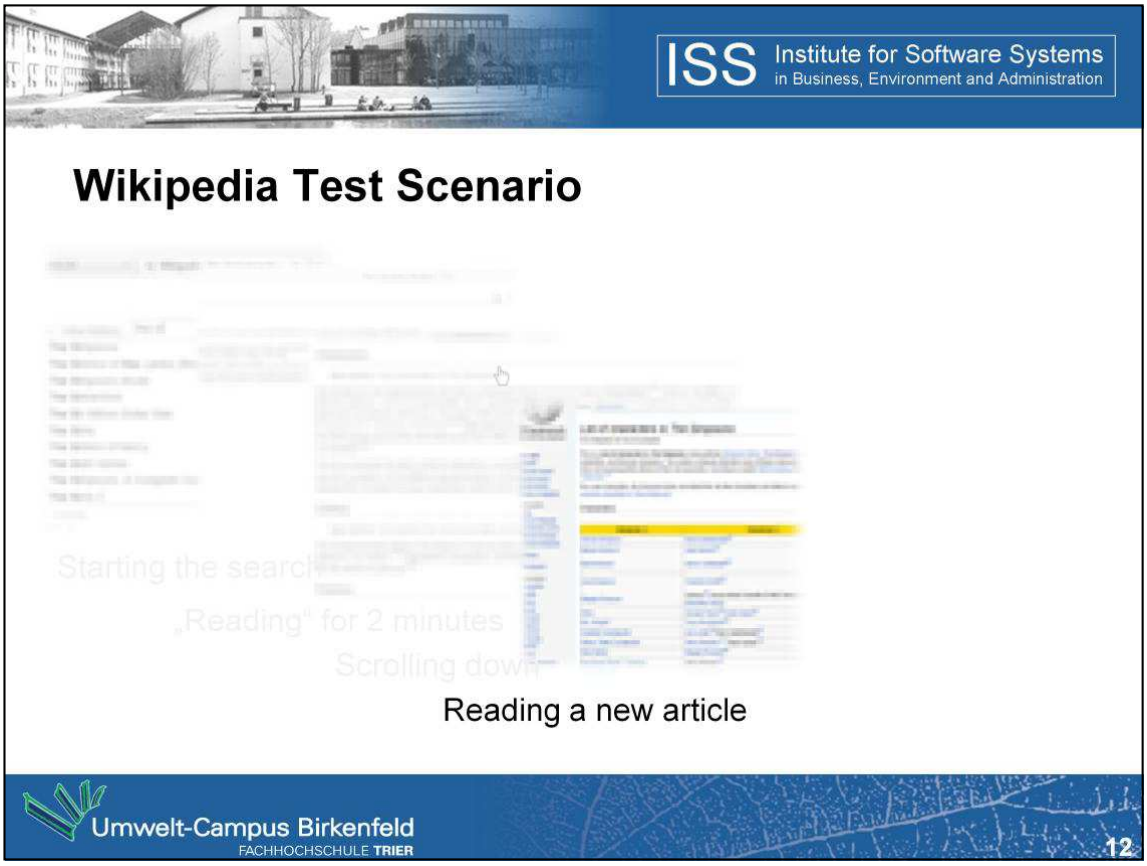
The next step was to simulate the reading operation:



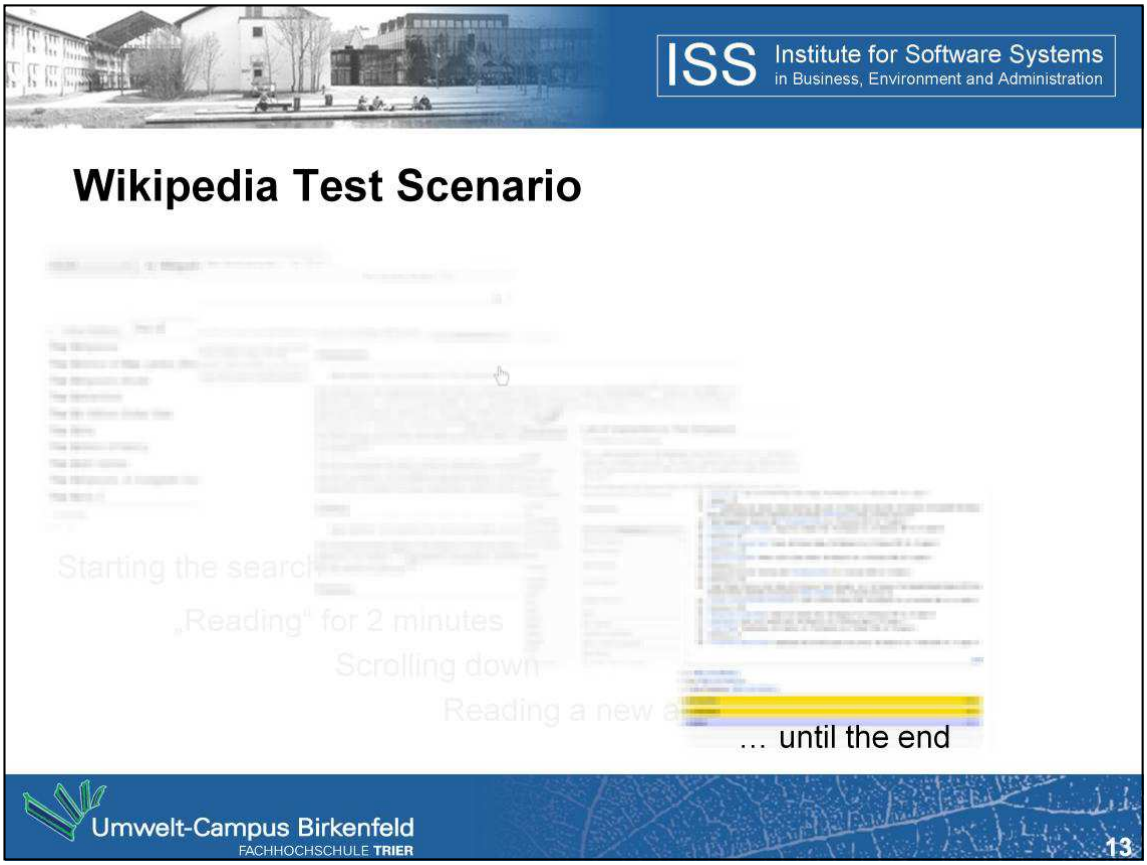
We did so by scrolling through the article and doing nothing for two minutes…



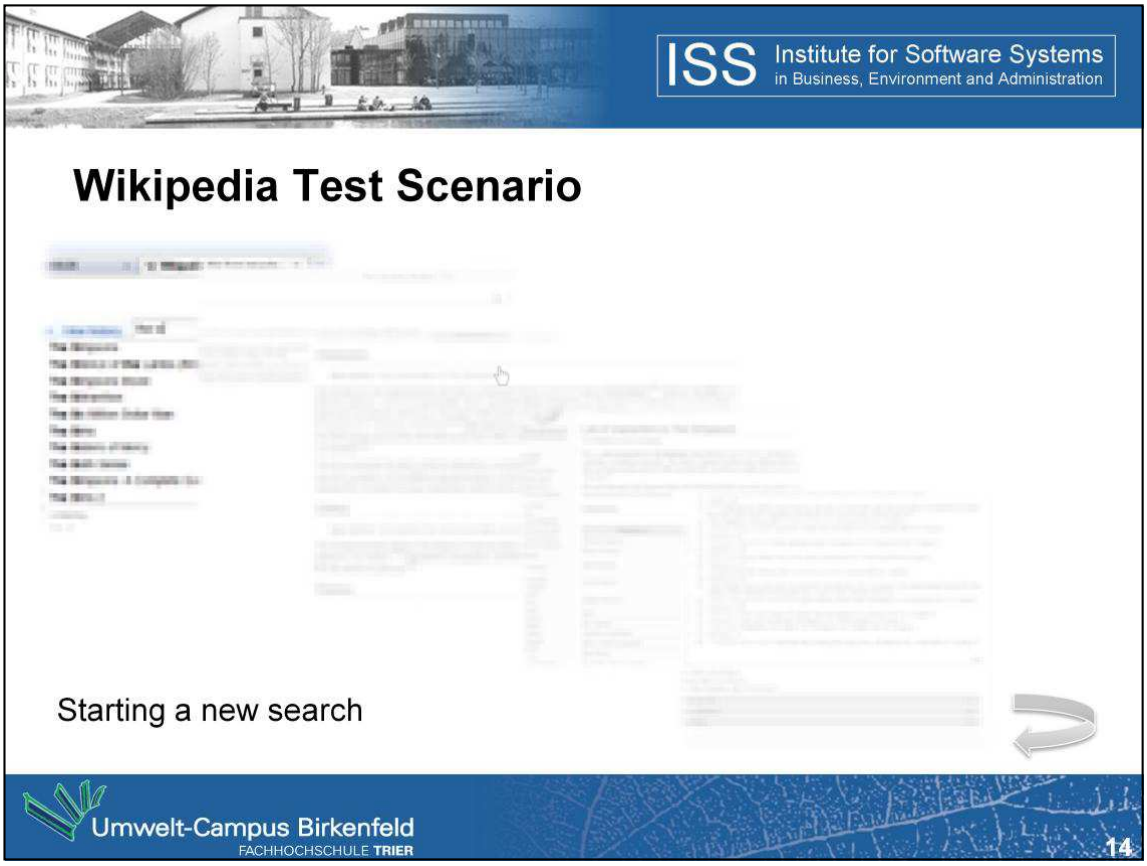
The user or rather our automation tool followed a link on the page…



And a new article is loaded

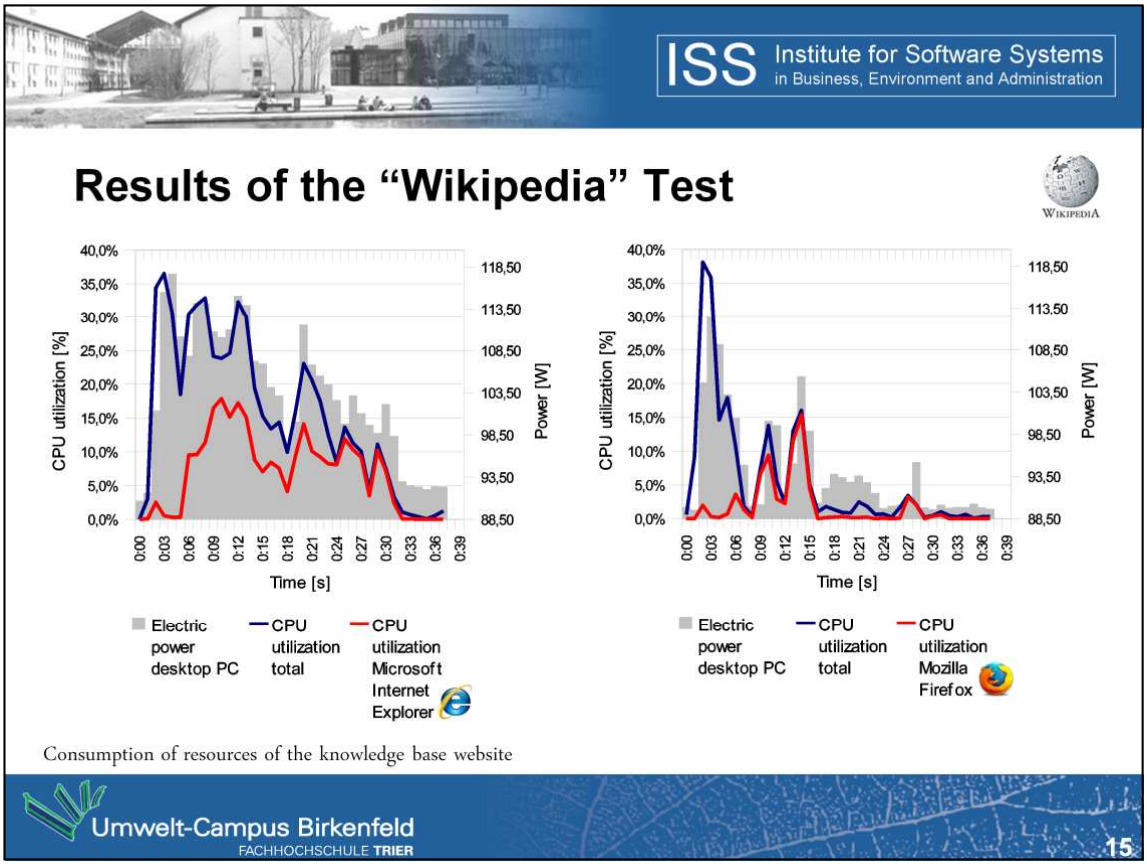


The user read this new article and scrolled until the end of it, means until the end of the shown website.



Afterwards a new search is

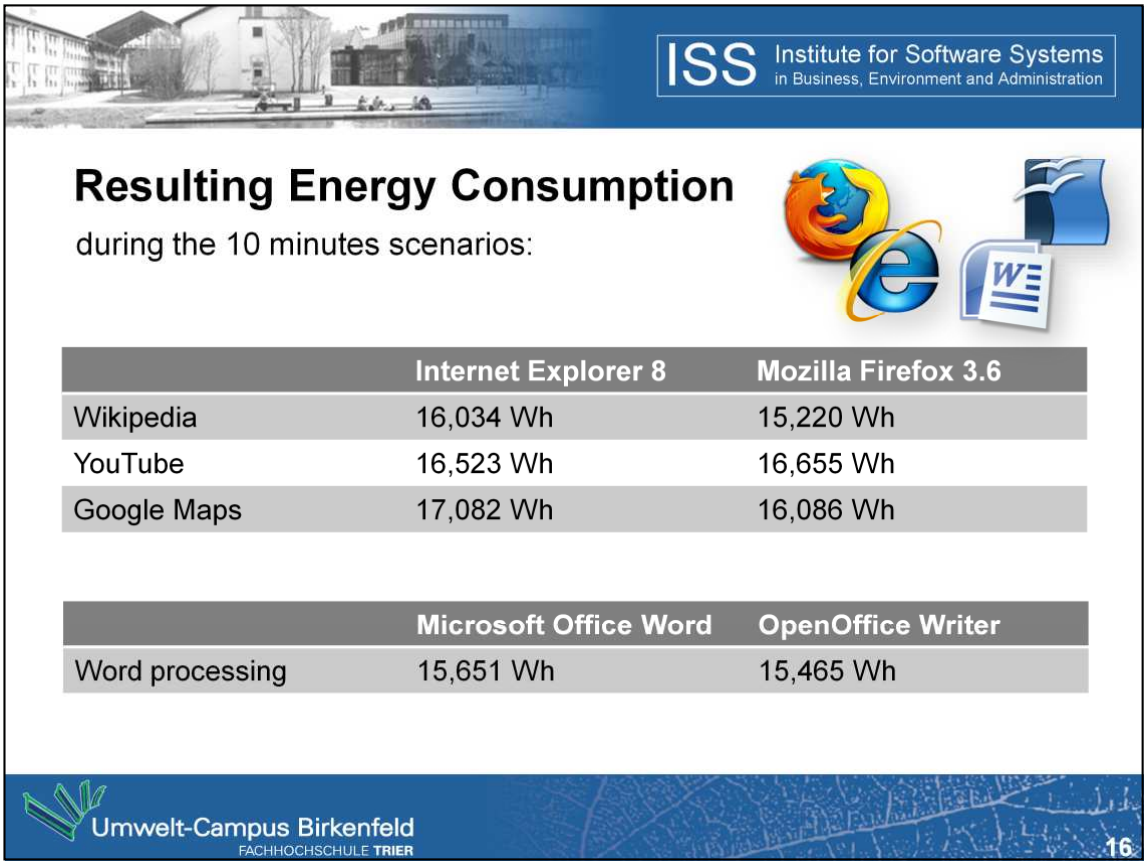
… and all the steps are repeated
So that the test runs for 10 minutes overall in the end.



Comparing the results of testing the two internet browsers different values of energy consumption can be detected.

Here you can see the results of testing the Internet Explorer (shown on the left) And of the Firefox (shown on the right)

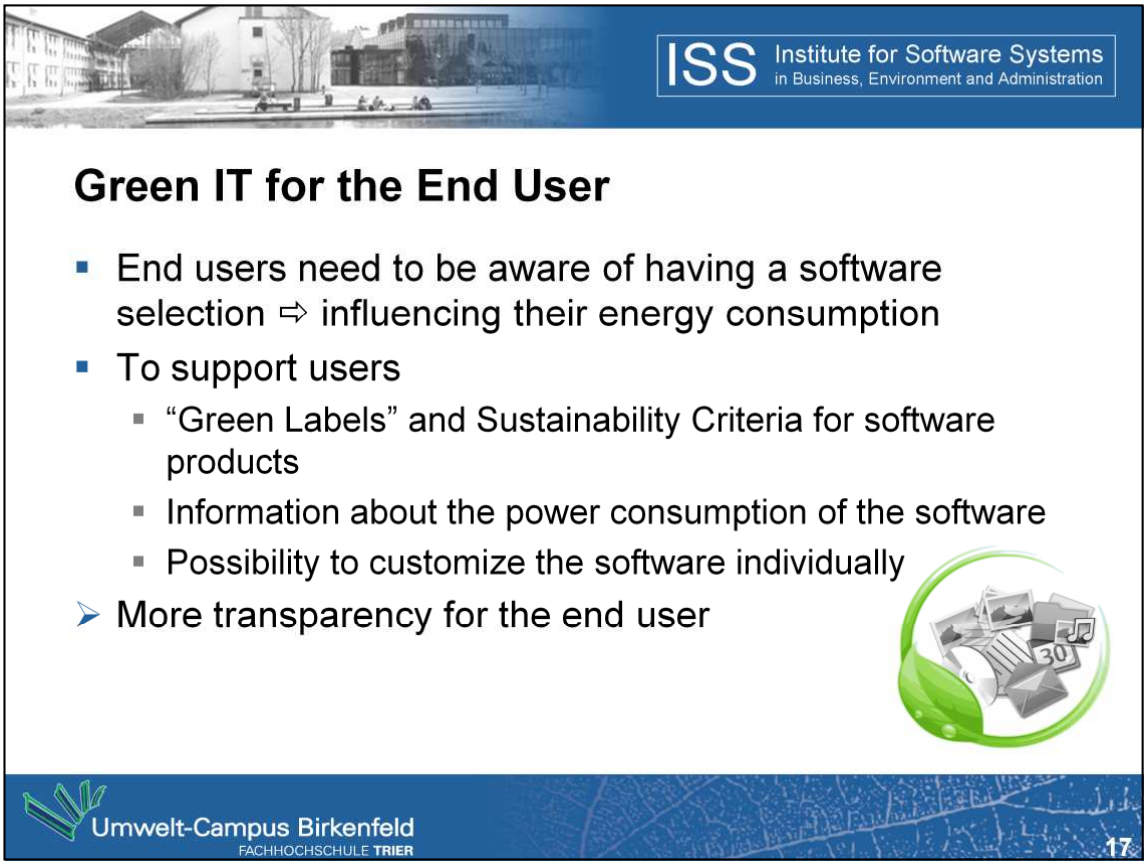
We chose the start of the search to show the resulting graph since this part is the most interesting part of the whole scenario. There you can see the biggest differences in the resulting values.
Even though the user is inactive the graphs show that the process is consuming energy.



Overall, means over the testing period of 10 minutes the Internet Explorer consumed about 16 Watt hours.

In contrast the Firefox needed only 15 and a half Watt hours while the actions were the same.

As you can see different values for the resulting energy consumption comes into notice for the internet browser as well as for the word processing applications. Overall it is shown that there is a relation between the selected software tool and the resulting electrical power consumption.



Consequently the user can influence the power consumption induced by his software usage.
The strength of a his influence force depends on the type of use.

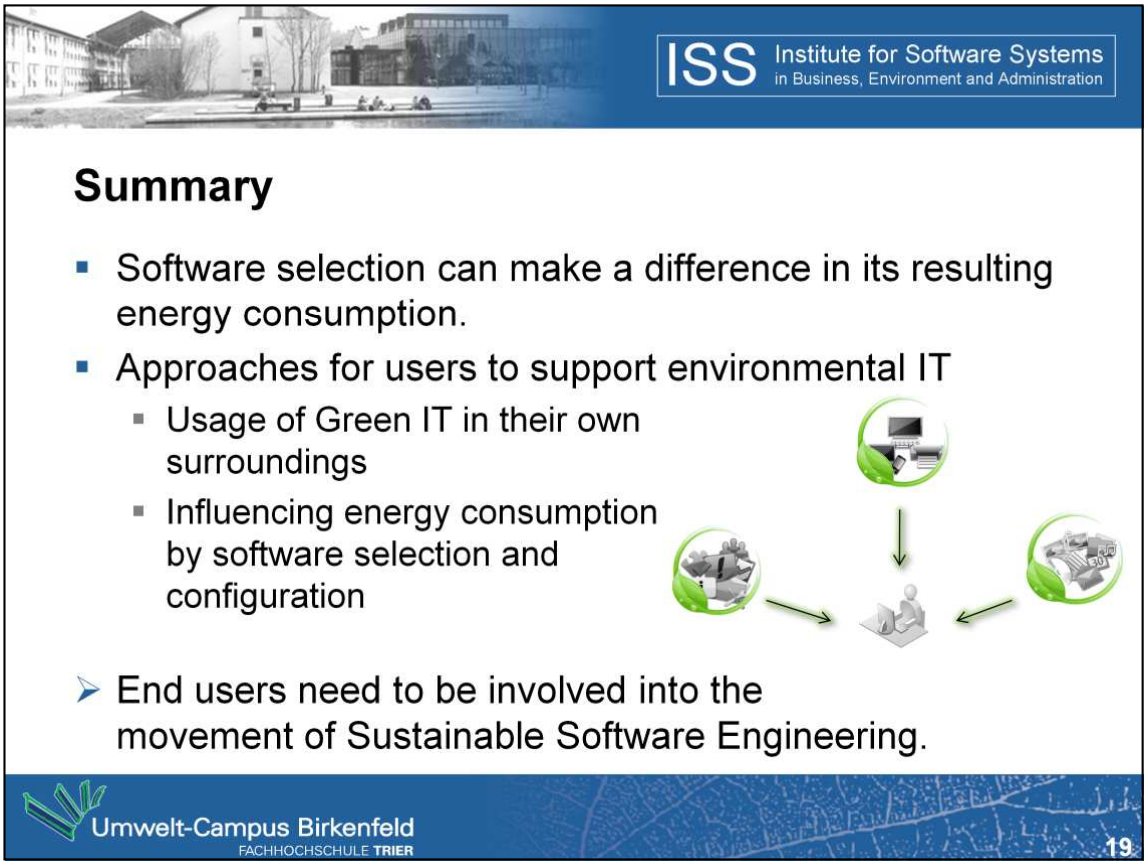
Hence, one first step towards Green IT for the end user is to draw his attention to the influence he can have.

On the other hand that is to say that the end user needs to be supported in his efforts.
- One possibility might be "Green Labels" for software products similar to the labels existing for hardware, like the Energy-Star.
- Software vendors should inform the user about the power consumption of the software

If the user sets a value on such information and labels, the market needs to react and the energy efficiency of software product becomes more and more important.
- Furthermore the software itself should be adaptable to the individual needs of the user, e.g. by offering a "light version" of a software product and plug-ins that can be added individually...

All in all it is necessary to get more transparency for the end user.

III. Summary & Outlook

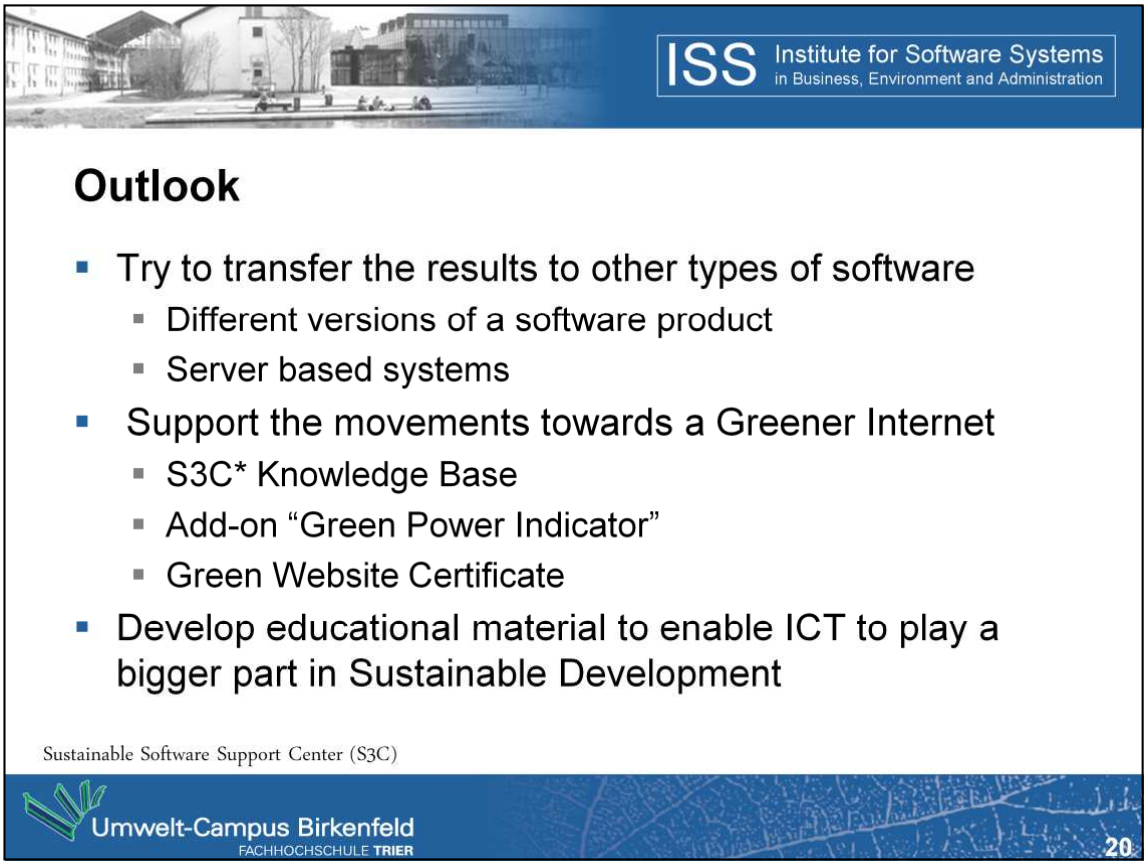


Summarizing, Software selection can make a difference in its resulting energy consumption.

There are different approaches for the professional or private users to support the development of environmental IT:

- They can use Green IT, so as hardware equipment with high energy efficiency, in their own surroundings.
- Additionally they can influence energy consumption by configuring their software and be aware of that point while selection their tools

That's why we think the end users need to be involved into the movement of Sustainable Software Engineering for example by giving information and, in that way, more transparency to him.



What we do in this context and our next steps are
-To try to transfer the results to other types of software, e.g. comparing different versions of a software product and testing server based systems.
- furthermore, we want to support the movements towards a Greener Internet

For that we are developing a knowledge base to support sustainable software development, administration, and use
Another project is an add-on that shows if a website is hosted on a green server.
And we are thinking about a certificate for green websites.

Additionally we want to develop educational material to enable ICT to play a bigger part in Sustainable Development.

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