

17th MARCH 2018



ANSIÃO


Testing the Energetic Consumption of Software: **Why** **and How**

VIII JORNADAS DE INFORMÁTICA



Me

Paulo José Estrela Vitoriano de Matos

PhD Student, Web Science and Technology
Test Manager,  NOVABASE

 <https://pt.linkedin.com/in/paulojosematos>



Agenda

- Hi, I'm here [2']
- **Why** Energy is Important ? [7']
 - Global Energetic Model
 - Challenges
 - Environment
 - Sustainable Development
- **How** we can help? [9']
 - Here we are: Testers!
 - Measure Tools
 - Sharing Results



UNIVERSIDADE
AbERTA
www.ua.pt



VIII Jornadas Informática ANSIÃO

Why

Why Energy (and its consumption) is Important ?



Why Energy is Important ?

Global Energetic Model

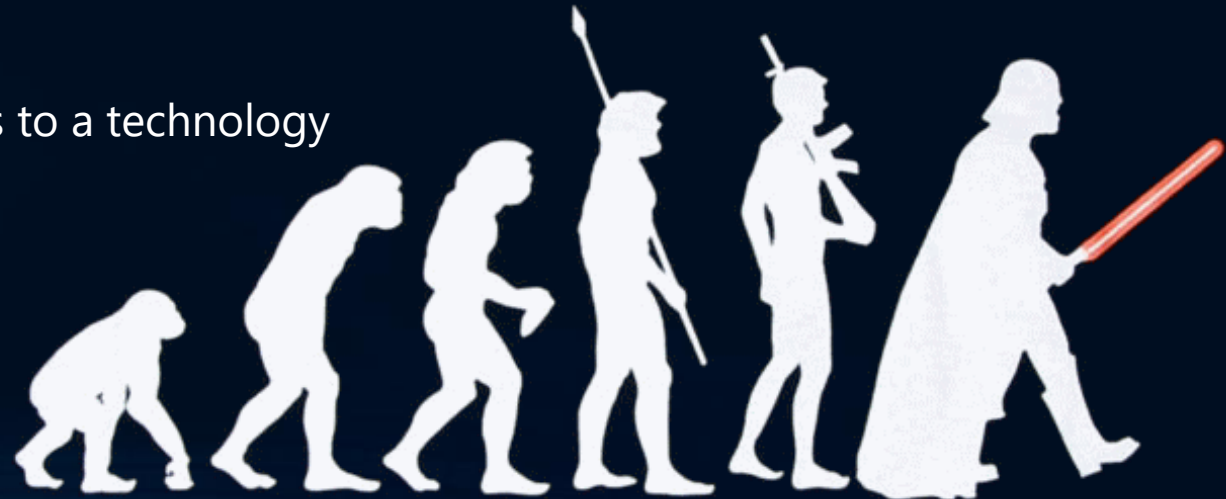
Mankind, has evolved further than in a biological way.

It has also evolved through the increased use of **technology in their habits**, although initially only in **concept hardware**.

The man today believes to possess a **virtual existence**, controlled and mediated by the intangible - **the software**.

This evolution is only reachable thanks to a technology called "electricity."

This technology is so important for humanity that it shaped his existence on **electricity ecosystem!**

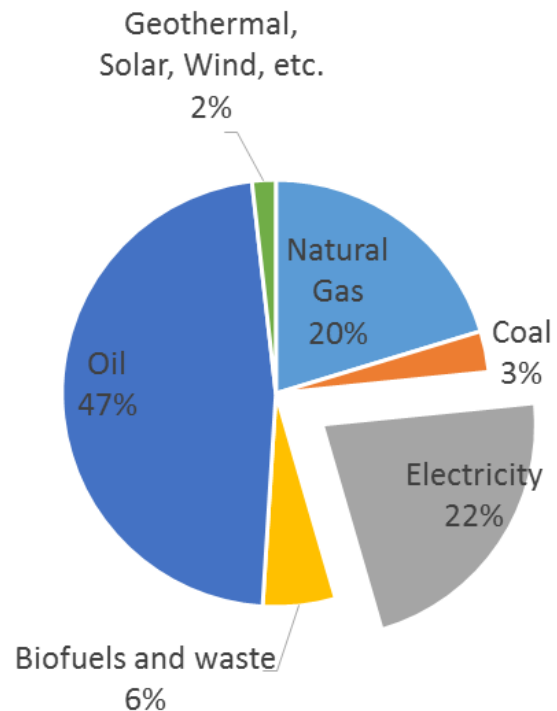




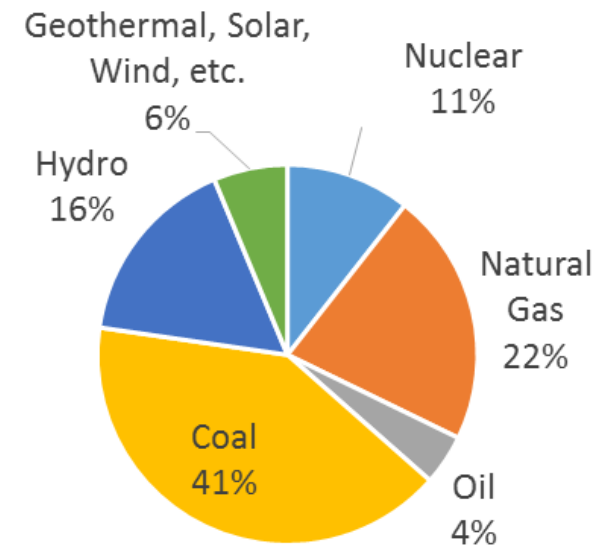
Why Energy is Important ?

Global Energetic Model

2014 - Total Final Consumption
by Fuel (Mtoe)



2014 - World Electricity
Generation by Fuel (TWh)

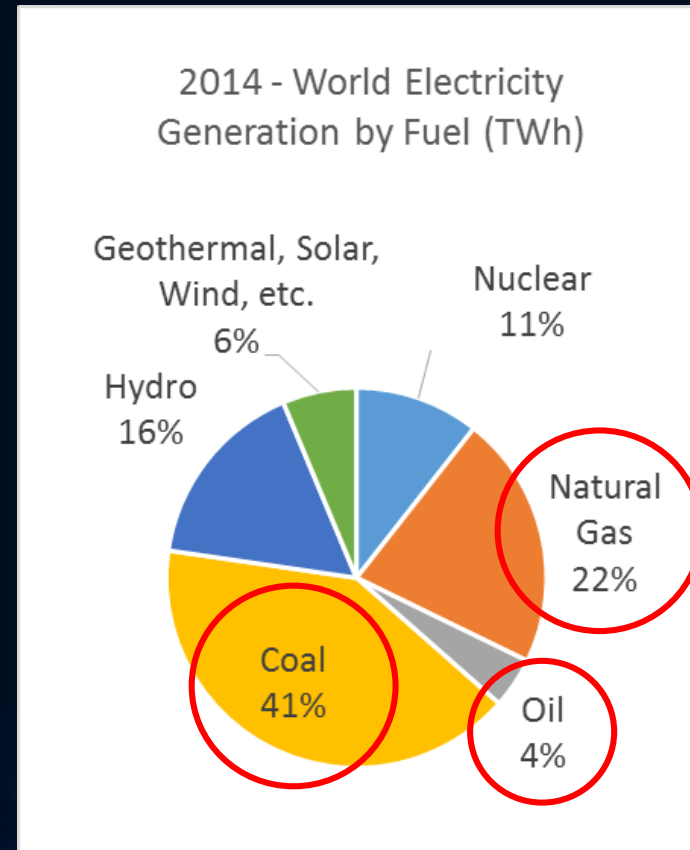




Why Energy is Important ?

Global Energetic Model

To generate electricity is used a majority non-renewable sources (**67%***) which emit near 40% of the total CO2 emissions in the world.





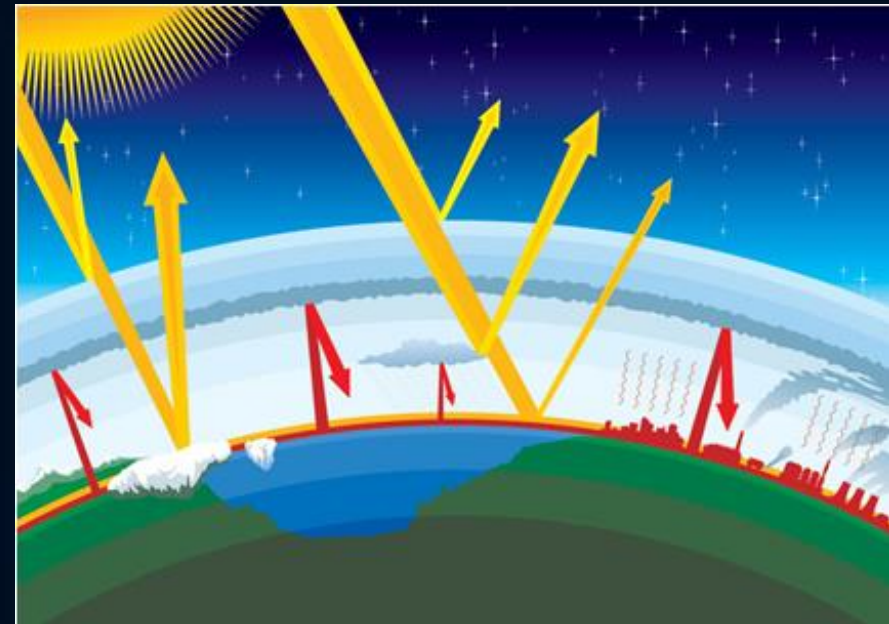
Why Energy is Important ?

Challenges: Environment

Climate Change

CO₂ is the main gas causing the greenhouse effect, and today the quantities emitted are excessive. So we are contribute effectively to the Climate Change.

The United Nations indicate for survival of the species (**including human**) the increase of temperature at planet just old more 2°C, at limit more 4° C.





Why Energy is Important ?

Challenges: Sustainable Development

Urban Populations Growing

In 2014, 1.3 billion people, i.e., 1 in every 5 of the world's population had no access to electricity.

In 2010 more than half the population lived in urban areas and it is expected that in 2050, 7 people in 10 are city residents.

Volts4Women
Sustainable energy for women and girls

1 in 5 people don't have access to electricity

Household air pollution is the second biggest cause of women's death after childbirth

SIX TIMES as many people die from the results of inhaling cooking smoke than from malaria

Lighting shouldn't kill...

Cooking shouldn't kill...

Give Women Power

Ashden
photo credit: Jerry Barnett/SolarAid



Why Energy is Important ?

Challenges: Sustainable Development

Sustainable Energy for All

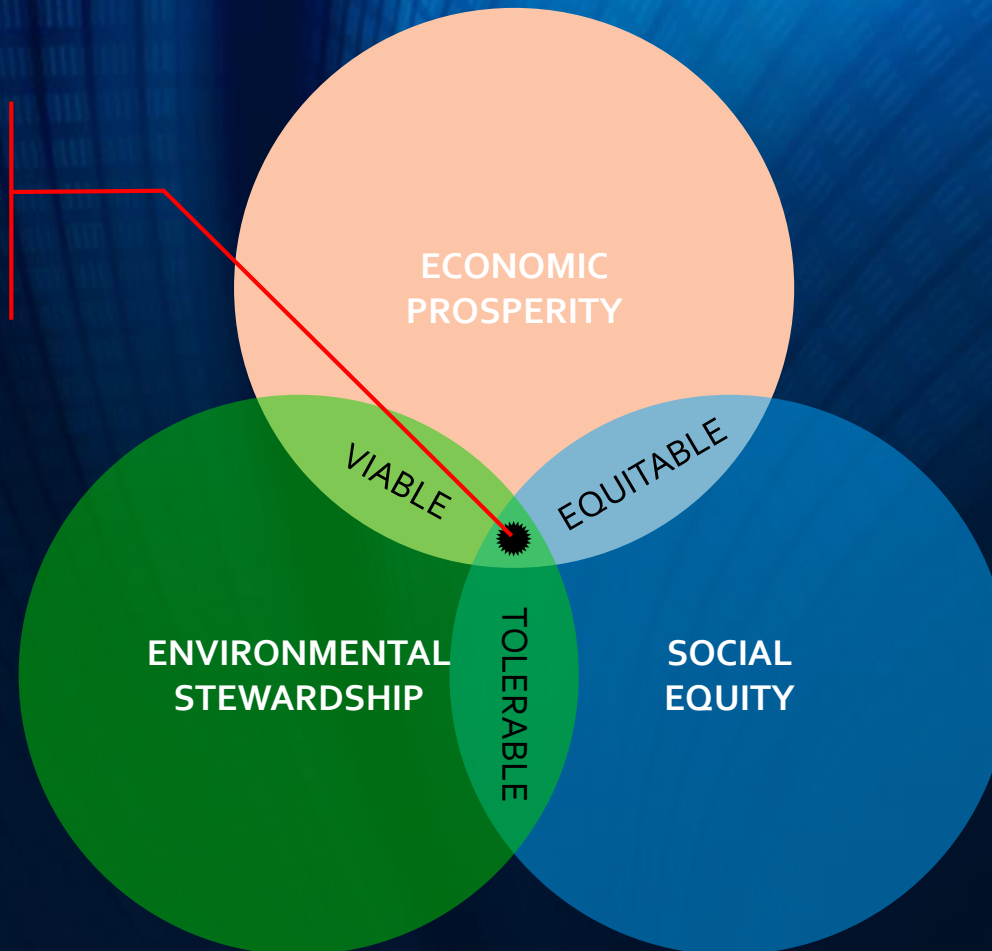
The United Nations alert to the energy paradigm of societies, in particular to the poorest countries, where it was agreed that the "energy" must be provided to all citizens as it's fundamental to the fulfillment of all the "Millennium Development Goals (MDGs)".





Why Energy (and its consumption) is Important ?

New Governance
Model: Sustainable
Energy 4All





UNIVERSIDADE
AbERTA **30**
www.ua.pt



VIII Jornadas Informática ANSIÃO

How

How we (**testers**) can help?



How we can help?

Here we are: Testers!

Software Testers are ready to help

A Software Tester performs an activity all over the software production cycle, from the collection of Requirements, to the support the delivery of the software product to customer or end user.

The Testing activity can be qualitative and quantitative by measurements at the code level, functionality or feature of a software program.

We live for Quality Assurance!





How we can help?

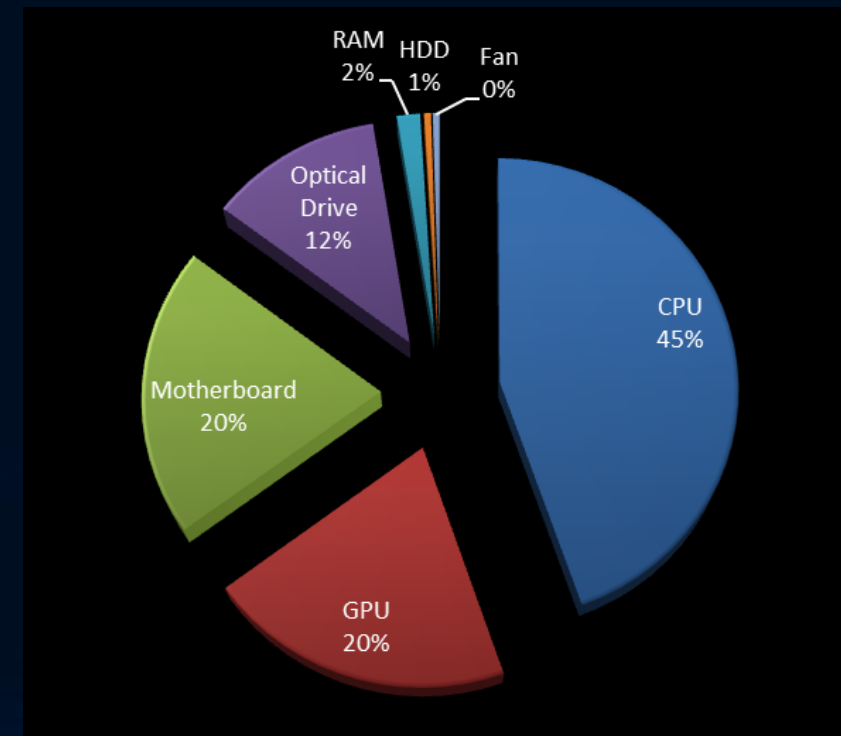
Here we are: Testers!

Where can we help?

A computer system, or computer, is the set of physical electronic devices (hardware) capable of performing algorithmic calculations in accordance with certain procedures defined by logical (software).

Actually, a computer consumes more than 65% of power capacity dealing with processing tasks (CPU+GPU).

Computer's Power Consumption Distribution





How we can help?

Here we are: Testers!

HW + SW as whole

A Software Tester can measure the energy consumption without established barriers between software and hardware.

The ISO 14756:1999 indicates:

“In order to measure the influence of software on the time behavior of a data processing system it is necessary to measure the time behavior of the whole system.”.

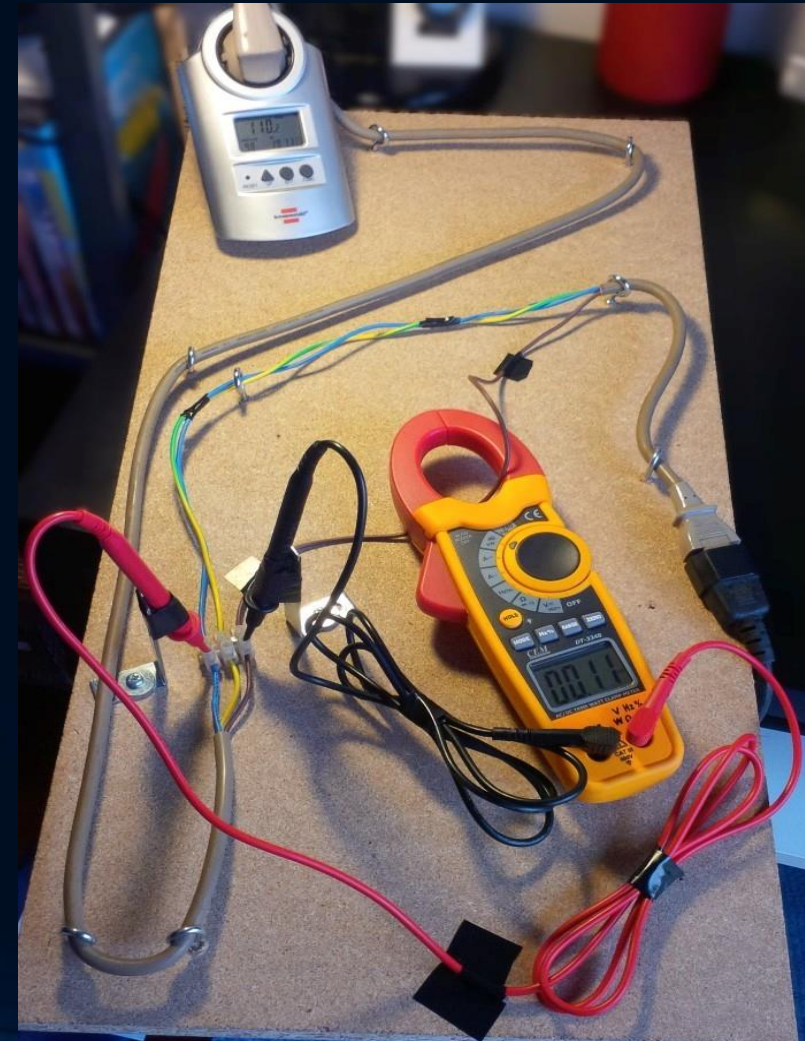


How we can help?

Measure Tools

We can measure the energy consumption by two ways: **physical** (direct and indirect) and **emulated** (simulated).

Physical measurement devices can be done with wattmeter (power meter) or a clamp-on meter.

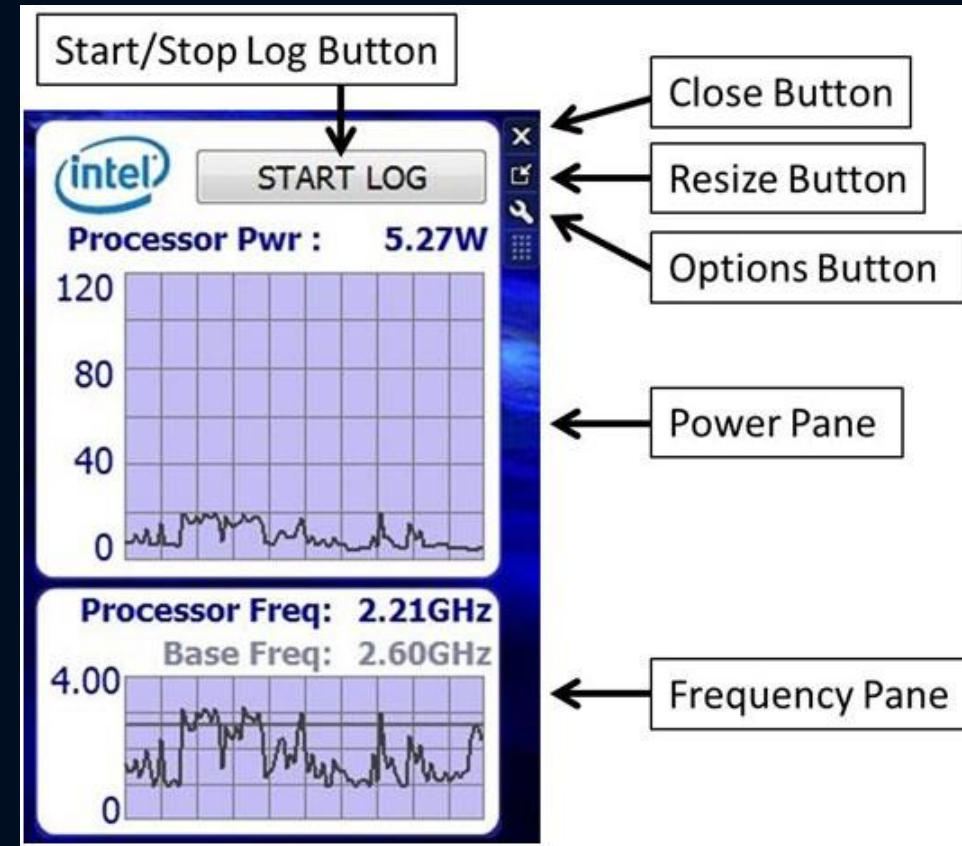


How we can help?

Measure Tools

There are also the measuring tools who simulated consumption:

- IPPET from Intel
- Joulemeter from Microsoft
- and more frequently add-ons for the integration into software development tools like Microsoft Visual Studio Energy Consumption profiler

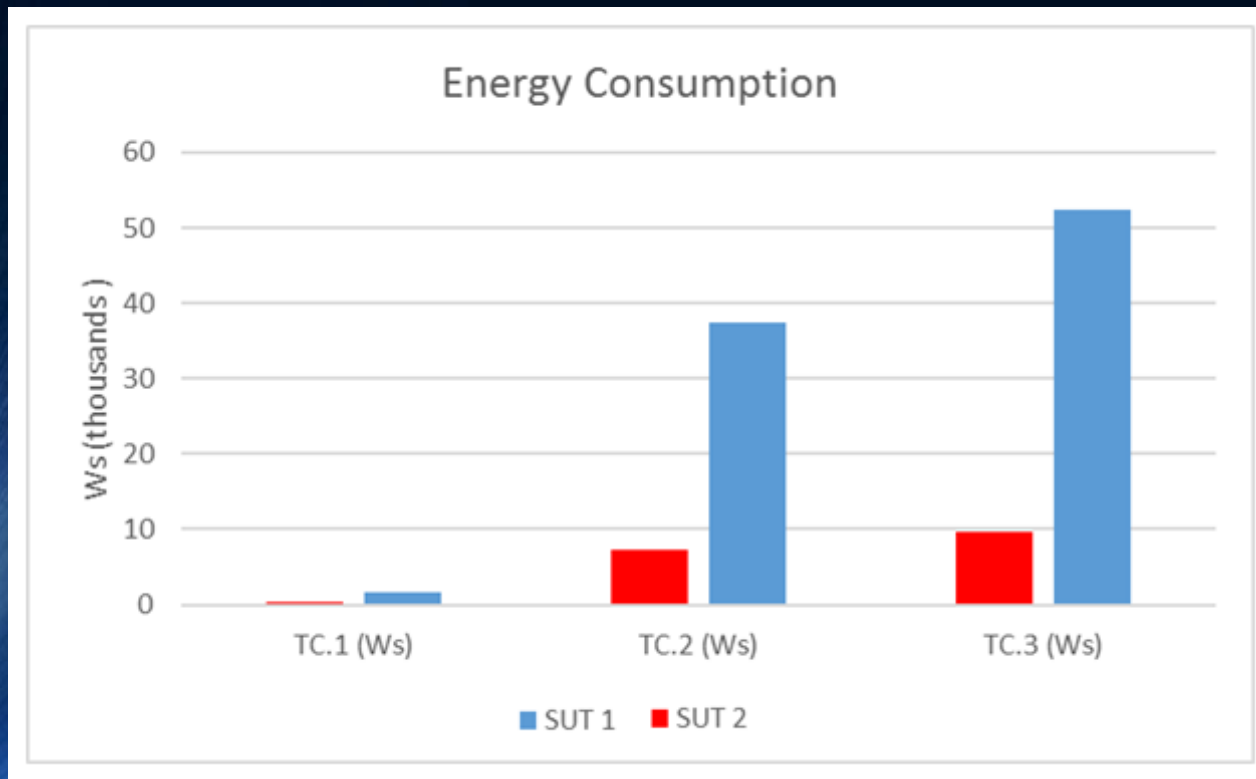




How we can help?

Sharing Results

Case Study A - mathematical algorithm



SUT	Energy Consumption			Max
	TC.1 (Ws)	TC.2 (Ws)	TC.3 (Ws)	Δ %
1	1555	37330	52462	3274 %
2	258	7312	9712	3664 %
Δ %	502 %	410 %	440 %	



How we can help?

Sharing Results

Case Study B – Best Browser Starting

Session-Based Testing

- Find the best browser to start-up with homepage of by the point of view of energy consumption. Each browser make 20 runs to capture the energy consumption average.

Browsers on test:

- Mozilla Firefox 45.0.1
- Microsoft Edge 25.10586.0.0
- Google Chrome Version 49.0.2623.110

Testing using

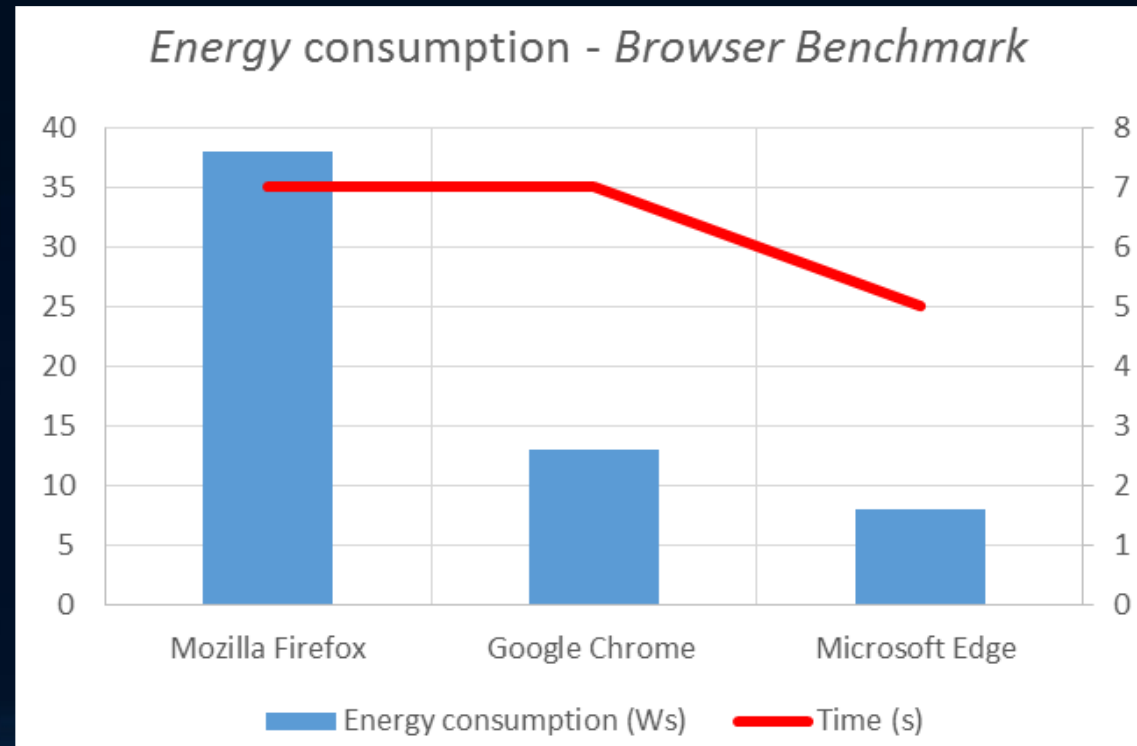
- Intel Platform Power Estimation Tool (IPPET)



How we can help?

Sharing Results

Case Study B – Best Browser Starting





How we (testers) can help?

- The **stakeholders** should know that energy consumption can be an **important requirement**
- The evaluation of energy consumption must be **done by independent and qualified testers**
- The **testers should identify the best tool** to each project given the variability and risks of imprecision of each type.
- Testing activity can be used to compare** to an earlier version of a our product, or is with similar product on market, or is only for knowing the performance on different platforms.
- We should not be surprised with **results** because we can find extreme situations:
 - > **4000% of energy consumption compared to the control version**

UNIVERSIDADE
AbERTA
www.uab.pt



THANK YOU