A Preliminary Study of the Impact of Software Engineering on GreenIT

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Information Technologies

French electricity consumption

13%

French ministries. IT & Sustainable Development report

Context
Information Technologies

13%

French electricity consumption

French ministries. IT & Sustainable Development report
Context

**Information Technologies**

13%

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Research Opportunities
**Information Technologies**

French electricity consumption

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**Research Opportunities**

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Context

Research Opportunities
Energy Monitoring Framework

PowerAPI

ADAM.lille.inria.fr

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Can we monitor the consumption of an application?
Can we monitor the consumption of an application?

0.5% error margin
What is the monitoring overhead?
What is the monitoring overhead?

0.2W overhead
How does it differ from a powermeter?
Breakdown

How does it differ from a powermeter?
Summary

• Accurate process-level estimation
• Support for CPU, Disk, Ethernet, RAM

• No hardware investment required
• Limited overhead
• Large-scale deployment

• Microscope «à la carte»
• On-demand configuration & adaptation

• Published in ICSE/Greens’12 & ASE’12

• Transfert in progress
• Freely available as OSS [1]
• GreenCodeLab + ADEME

Empirical Case Studies

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What is the cost of programming languages?

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Language Footprint

Tower of Hanoi (recursive, logarithm scale)
Tower of Hanoi (recursive, logarithm scale)
Tower of Hanoi (recursive, logarithm scale)

Language Footprint

- Perl
- Python
- Ocaml opt
- Ocaml
- Prolog
- Pascal

- Java
- C++, O3
- C++, O2
- C++

- C, O3
- C, O2
- C
Where is spent the energy inside my app?

Case study

- Complex application: > 88,000 SLOC
- Apache JMeter to stress Jetty’s examples
- One minute, 20 threads, loop count of 500
- 146 monitored classes & 726 methods
Class-level consumption

- io/AbstractBuffer: 39%
- io/ByteArrayBuffer: 24%
- server/Request: 4%
- util/Utf8Appendable: 4%
- io/View: 3%
- server/HttpConnection: 2%
- io/BufferCache: 2%
- Others: 22%

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Class-level consumption

io/BufferCache 2%
server/HttpConnection 2%
io/View 3%
util/Utf8Appendable 4%
server/Request 4%
io/ByteArrayBuffer 24%
io/AbstractBuffer 39%
Others 22%

7 classes out of 146 ~80% energy
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Top10 consuming methods

CPU Energy %
Number of Invocations

Top10 > 50% (of 726, 1.3%)
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## Related Work

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QUESTIONS
Life Cycle Assessment (LCA) for a common PC

Duan & al. Life cycle assessment study of a Chinese desktop personal computer
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Scalability

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![Graph showing Scalability](image)

- **PowerAPI**
- **Application(s)**

**Watt (W)**

**Time (s)**
Scalability

Monitoring 1 application → Monitoring 170 applications

![Graph showing scalability with time and power consumption](image)

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### State of the Art

- **PowerTop**
  - No reusable libraries

- **JouleMeter**
  - Not easy to support platform interoperability

- **pTop**
  - Development is over
  - Manual calibration

- **EnergyChecker**
  - Requires external device