# A year in transition

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# UCLouvain









www.**enmieux**.be

LE FONDS EUROPÉEN DE DÉVELOPPEMENT RÉGIONAL ET LA WALLONIE INVESTISSENT DANS VOTRE AVENIR

# Outline









Personal journey

Transition triggers

Pillars for socio-ecological transition in ICT R&D

A year in transition in UCLouvain ECS group



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Social-ecological transition

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# ISSCC 2012 – IEEE JSSC 2013

Microcontroller SoC	This work	TI, ISSCC, 2011	MIT, ISSCC, 2008
CPU	16-bit MSP430 comp.	16-bit MSP430	16-bit MSP430 comp.
Technology	65nm LP/GP CMOS (dual core oxide)	0.13µm LP CMOS + FeRAM	65nm LP CMOS
Memory	64B I\$ + 18kB SRAM	32B I\$ + 1kB SRAM + 16kB FeRAM	8B  \$ + 16kB SRAM
Die area	Core: <b>0.42mm²</b> Total: 0.66mm²	Total: 4.4mm <sup>2</sup>	Core: 1.62mm <sup>2</sup> Total: 4.26mm <sup>2</sup>
External supplies in minimum configuration	Single $V_{dd}$ = 1-1.2V $f_{xtal}$ = 32-100 kHz -	Single V <sub>dd</sub> = 2.0-3.6V - -	Single $V_{dd}$ = 1.2V $f_{xtal}$ $f_{MCLK}$ ~ 300 kHz @0.5V
Speed performances	25 MHz @0.40V (25°C) 25 MHz @0.44V (-40°C)	24 MHz	434 kHz @0.5V (25°C) 300 kHz @0.5V (0°C)
Active power	<b>7 μW/MHz</b> @0.4V	164 μW/MHz (FeRAM) 130 μW/MHz (SRAM)	27.3 μW/MHz @0.5V
Sleep power	1.5 μW @25°C 17 μW @85°C	< 6 μW @85°C	< 1 μW  @25°C ~ 7 μW @75°C
Embodied energy and carbon footprint for <b>fabrication</b> of 1M units	195 GJ <b>11 T CO<sub>2</sub>e</b>	870 GJ 55 T CO <sub>2</sub> e	1060 GJ 60 T CO <sub>2</sub> e

=	Google Scholar	"carbon footprint" source:solid source:circuits
٠	Articles	6 results (0,04 sec)
	Any time Since 2020 Since 2019 Since 2016 Custom range	SleepWalker: A 25-MHz 0.4-V Sub-mm <sup>2</sup> 7-μW/MHz Microcontroller in 65-nm       [PDF] ieee.org         LP/GP CMOS for Low-Carbon Wireless Sensor Nodes       [PDF] ieee.org         D Bol, J De Vos, C Hocquet, F Botman Solid-State Circuits, 2012 - ieeexplore.ieee.org       [PDF] ieee.org         cost nodes. As the IoT calls for the deploy- ment of trillions of WSNs, minimizing the carbon footprint for WSN chip manufacturing further emerges as a third target in a design-for-the-environment (DfE) perspective. The SleepWalker
	Sort by relevance Sort by date	<ul> <li>♀ 99 Cited by 143 Related articles All 9 versions ≫</li> <li>A 25MHz 7µW/MHz ultra-low-voltage microcontroller SoC in 65nm LP/GP CMOS [PDF] ieee.org</li> </ul>
	<ul> <li>✓ include patents</li> <li>✓ include citations</li> </ul>	for low-carbon wireless sensor nodes       Deal, JDe Vos, C Hocquet, E Bolman,
		[CITATION] SSCS DL Jake Baker Is a Volunteer at Undergrad MIDAS Festival in         Dublin [People]         K Olstein - IEEE Solid-State Circuits Magazine, 2014 - ieeexplore.ieee.org         Michael Perrott —Ayman Shabra At Masdar City, a zero carbon footprint campus (from left): Lutfi         Albasha, Chen Zhang, Yonatan Kifle, Rakesh Kumar, Abe Elfadel, and Ahmed Elian. F SSCS         DL Jake Baker Is a Volunteer at Undergrad MIDAS Festival in Dublin … <sup>(2)</sup> 99 All 2 versions <sup>(3)</sup>

#### A 65 nm 0.5 V DPS CMOS image sensor with 17 pJ/frame. pixel and 42 dB dynamic range for ultra-low-power SoCs

N Couniot, G de Streel, F Botman ... - ... Solid-State Circuits, 2015 - ieeexplore.ieee.org ... Second, the bill-of-material and carbon footprint for WSN production must Manuscript received December 22, 2014; revised April 11, 2015, June 19, 2015; accepted July 15, 2015. This paper was approved by Associate Editor Ken Suyama ...

☆ 99 Cited by 22 Related articles All 6 versions >>>

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[PDF] ieee.org



Social-ecological transition

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### Challenges for a sustainable IoT:



Avoiding battery replacement

[D. Bol, « Can we connect trillions of IoT smart sensors in a sustainable way », IEEE S3S 2015]

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# Transition triggers



• 2017 - : Seminars for general audience on the Internet footprint

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# Transition triggers



• 2017 - : Seminars for general audience on the Internet footprint

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# Transition triggers



Coltan mine in North Kivu (Congo) Copyright: Stefano Stranges • 2018 : ENCOS workshop at UCLouvain

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# Transition triggers

 Dec, 2018 : Mildly bashed on social network after seminar at ETH Zurich

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David Bol Assistant Professor at Université catholique de Louvain 1yr • 🚱

Just landed in Zürich to give a talk at ETHZ on ULP socs for a sustainable IoT.



🕙 28 · 2 Comments

### Philippe Greiner • 1st

Data Science & Process Modeling, Electromechanical Engineer - Technord

It takes half a day to go to Zurich by train; compensating for the extra CO2 of the flight will take quite some sustainable IoT ;)

Like · 🕚 1 | Reply

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# Transition triggers





# Ver va cumun autoritation

### Pierre-Yves Gomez Le travail invisible

Enquête sur une disparition



FRANÇOIS BOURIN ÉDITEUR



Vivre l'effondrement (et pas seulement y survivre)

Par les auteurs de COMMENT TOUT PEUT S'EFFONDRER #

### The Digital Tower of Babel

Big data,blockchain, quantum computing, artifical intelligence, 5G, self-driving cars, brain-computer interface, IoT, ...

# No exponential is forever ... but forever can be delayed.

- Gordon E. Moore



The time is now for engineers to stop following blindly these exponential trends

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 The social-ecological transition answers environmental change with social progress. – Prof. E. Laurent, 2015

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# Step #0 : realize that we are limited

• Time:

- 24 hours in a day
- Space: finite number of office desks
- People: finite number of people capable/willing to be good PhD researchers
- Publications: finite number of papers in <u>good</u> journals/conferences

# Being able to say 'no'

# Step #1 : selecting meaningful applications



- Positive ecological or social impact compatible with GHG emission reduction plan
- Focus innovation on fundamental needs

# Step #1 : selecting meaningful applications



Replace KPI drive by reduction in carbon / energy / resource footprint (caution: ≠ efficiency !!!)

# Step #1 : selecting meaningful applications



### Social link

- Limit the potential for
  - abusive/detoured use of the innovation
  - rebound and systemic effects
- Must involve stakeholders



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# Example: audio sensing



<u>Ultra-low-power miniature</u> <u>batteryless vocal assistant</u> <u>supplied by solar power</u>

✓ Footprint reduction

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- × No fundamental need fulfilled
- × Risk of rebound + detour



Acoustic forest monitoring

to detect fire starts, illegal sawing, poaching and monitor biodiversity

- ✓ Low footprint
- ✓ Ecological benefits
- Limited risk of detour

# Dropped projects

- In 18 months, we refused at least 4 projects driven by companies because of no agreement on the target market
- Requires time to align with the companies
- Requires pedagogy to communicate

Step #2 : partnering with the right people / entities / companies

- Human aspect
- Open mindness
- Capability to follow the transition:
  - enough decision power
     and autonomy with respect to the shareholders
  - or already transition-oriented
- Hunt greenwashing and resort to facts (instead of ideology)



- 3. More resilient research activity Next steps
  - Identify dependency on major global companies
  - Consider open source alternatives and service from smaller local service providers
  - Caution: resiliency vs. efficiency
- 4. Participative governance

Challenges:

- Resiliency Local organization Social link
- identify key fundamental research questions
- happy sobriety mindset (philosophical work)
- preserve a sufficient level of "economic" success for the activity to be sustainable



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