ENTRA: Whole-Systems Energy Transparency

Framework 7 FET (MINECC) Project, 1.10.2012 - 30.9.2015

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Wasted potential

Huge advances have been made in power-efficient hardware. Various software-controllable energy-saving features available, such as DVFS.

BUT – potential energy savings are wasted by

- software that does not exploit energy-saving features of hardware;
- poor dynamic management of tasks and resources.

Energy transparency

Energy transparency the central concept of the ENTRA project.

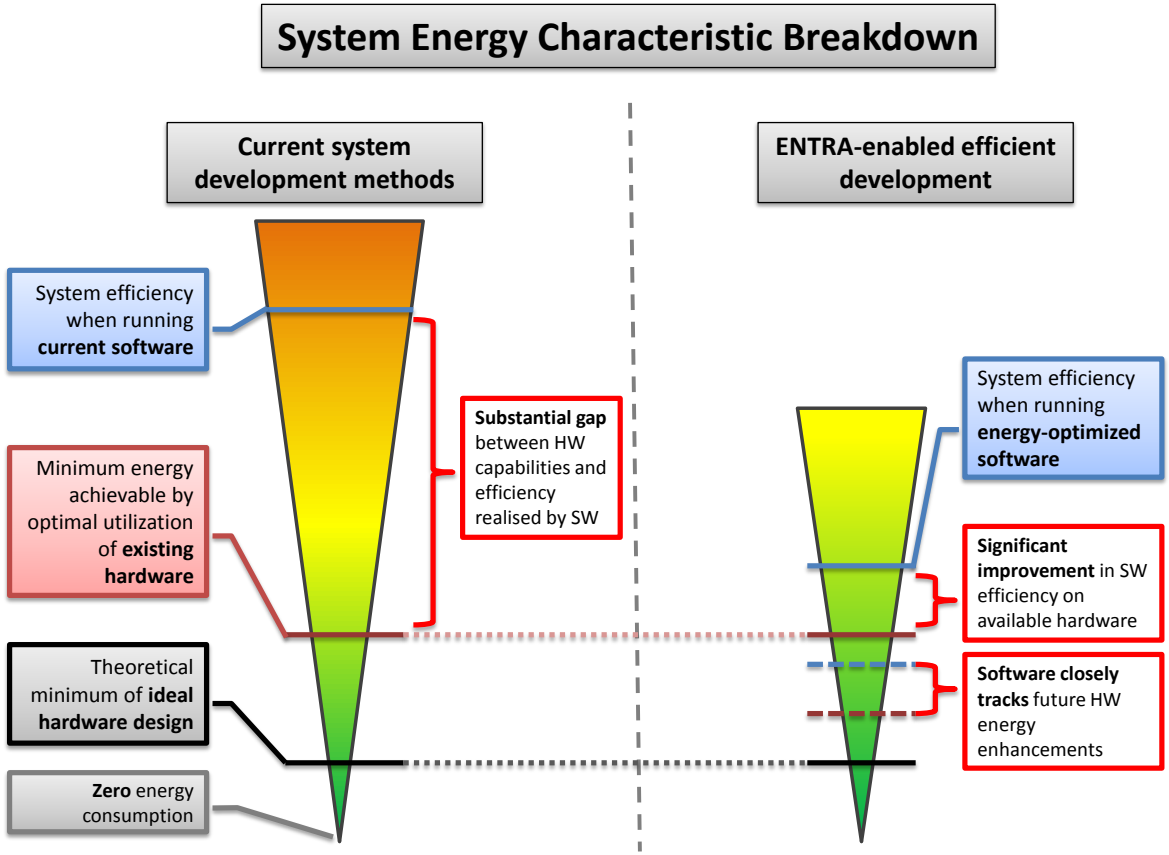
Information on energy usage available for programs;

- without executing them;
- at all levels from machine code to high-level application code.

Partners and Competences

Roskilde University Denmark	Bristol University UK	IMDEA Software Inst., Spain	XMOS Ltd. UK
(Coordinator) analysis, optimisation	Modelling, toolchains, system design	Analysis, optimisation, verification	Modelling, HW platform, benchmarking
	University of BRISTOL	imdea instituto madrileño de estudios avanzados	XMOS

Towards the limit



Key techniques

Program analysis

- Static analysis - abstract interpretation of code
- Dynamic analysis - information collected from traces

Hardware-software energy modelling

- detailed low-level models of machine instructions;
- energy models of high-level programming abstractions.

Assertion language

- linking models to analyses;
- providing basis for user tools

Optimisation

Program transformations

- Specialisation - compiling away software engineering idioms
- Parallelisation, re-ordering
- Energy-optimised compilation

Trade-off of energy against quality of service

- Saving energy by delivering "good enough" or "fast enough" results, rather than optimal

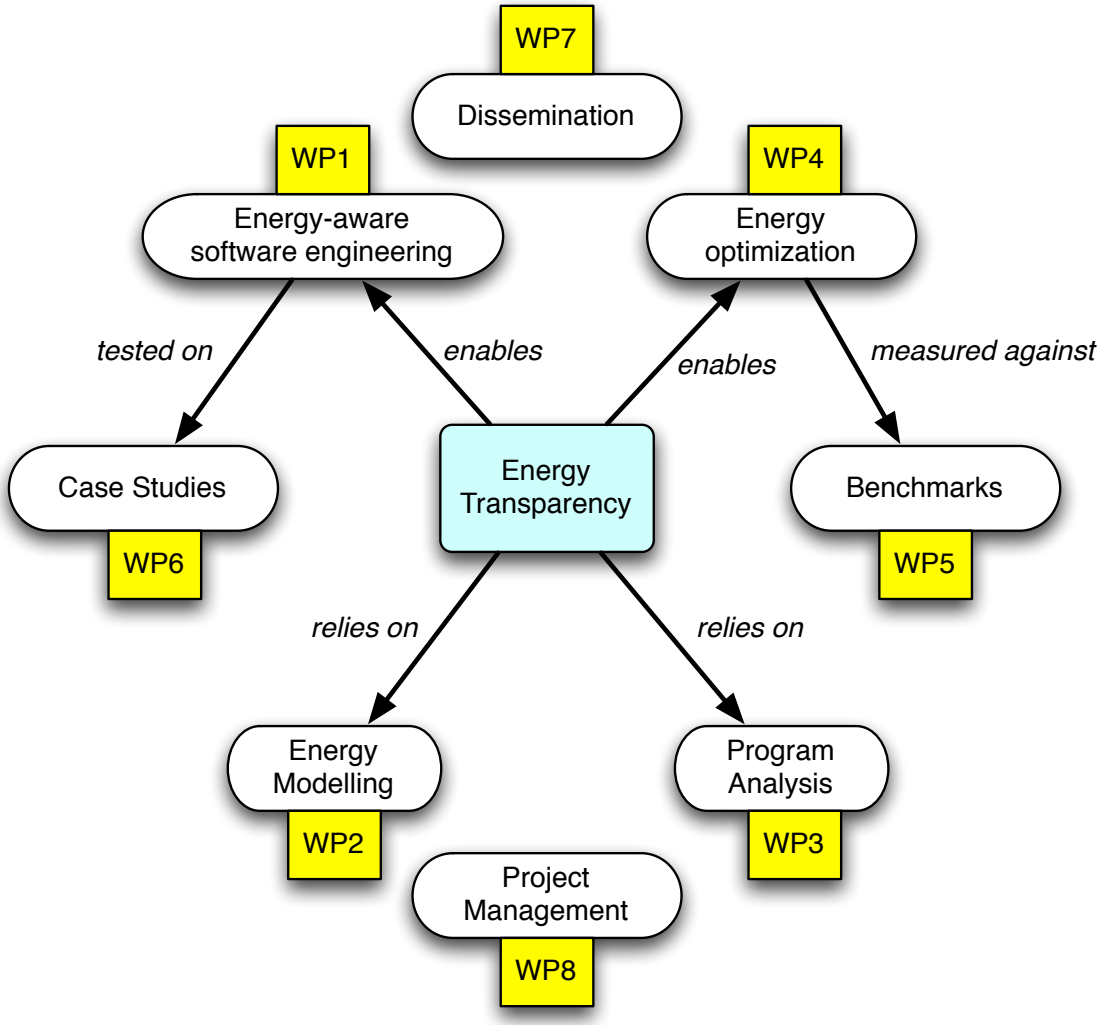
Trade-off of energy against quality of service

- Energy-aware scheduling

Metrics, Benchmarks and Case Studies

- Metrics: energy consumption on the XCore.
- Hand-optimised benchmarks: giving "idealised" performance exploiting energy-saving optimisation and hardware features.
- Case studies: XC applications covering a range of optimisation opportunities. E.g. real-time controllers, media players, event-driven communication.

Project organisation



Impact

Longer term: fields impacted by energy transparency.

- Algorithms and complexity: finding the most energy-efficient "hardware fit" for algorithms.
- Tools and techniques for holistic "Real-Energy" Programming.
- High-performance computing and data centres: energy consumption a major concern.
- Sustainability of global ICT growth: at current levels, ICT will consume 18% of world's energy by 2030.

The FET MINECC Project Cluster

ENTRA is one of 7 projects in the MINECC FET Proactive area.

Overall aim: reducing energy consumption "to the limit".
Other project topics:

- Ultra low power computing architectures for embedded sensing.
- Dynamic energy management at run time (harvesting/consumption balance).
- Theoretical understanding of energy consumption limits in physical switches, the Landauer limit and thermodynamics.

Future joint MINECC events: an EACO workshop?