Energy-Aware COmputing

The **EACO** Initiative at Bristol

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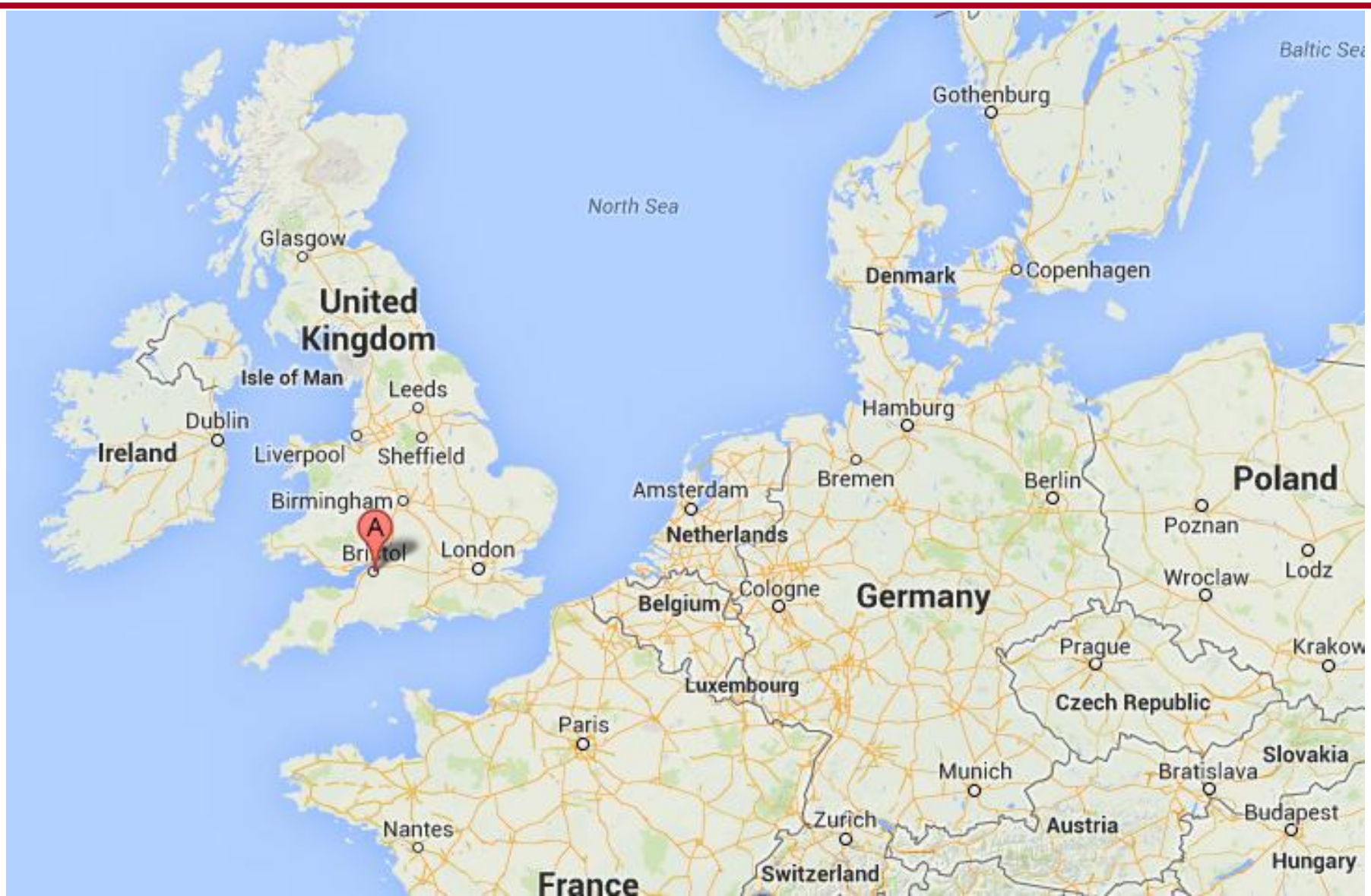
Department of
COMPUTER SCIENCE

The Royal Academy
of Engineering

XMOS®

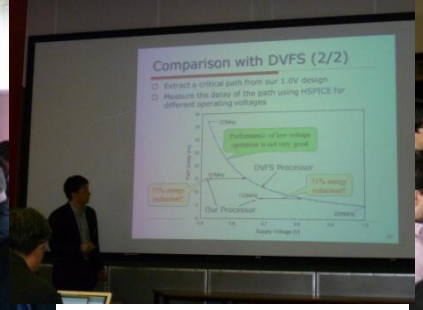
Bristol


Baltic Sea
Gothenburg
North Sea
Glasgow
Denmark
Copenhagen
United Kingdom
Isle of Man
Leeds
Hamburg
Dublin
Ireland
Liverpool
Sheffield
Bremen
Berlin
Poland
Amsterdam
Birmingham
A
Netherlands
Poznan
Bristol
London
Wroclaw
Lodz
Belgium
Cologne
Germany
Prague
Krakow
Luxembourg
Czech Republic
Paris
Slovakia
Munich
Bratislava
Zurich
Austria
Budapest
Nantes
Switzerland
Hungary
France

The University of Bristol

- 1876, University College
- UoB founded in 1909
  - The first higher education institution in England to admit women on an equal basis to men. ☺
- Top 30 universities globally

  (QS World University Rankings)
- 6 Faculties
- ~14.000 students, 2.000 in FEN
- Computer Science in FEN
- 9 FEN research groups
  - Microelectronics





EACO @ Bristol

The Energy-Aware COmputing Initiative, Research Agenda and Workshops

http://www.cs.bris.ac.uk/Research/Micro/eaco.jsp

Purpose of the EACO Initiative

"To bring together researchers and engineers with interests in energy-aware computing for discussions to identify **Intellectual Challenges** that can be developed into collaborative research projects.

We strive to go significantly beyond the state of the art."

[IAS funding application Jan 2010]

Energy-Aware COmputing

- So far 6 dedicated EACO workshops at Bristol:
  - http://www.bristol.ac.uk/ias/workshops/current-workshops/energy-aware-computing.html
  - http://www.cs.bris.ac.uk/Research/Micro/eaco.jsp

- Next EACO Workshop (EACO W7):
  - Summer 2014

Institute for Advanced Studies University of Bristol

iNets South West Microelectronics

European Regional Development Fund: Investing in your Future

- Intellectual Challenges
  - Inclusive (up/down system stack)
  - Radically new innovative approaches
  - Strong industrial engagement: Industrial Partners
  - TR: Intellectual Challenges in Energy-Aware COmputing

http://www.cs.bris.ac.uk/Research/Micro/files/eaco/eaco_w4_intellectual_challenges.pdf

EACO Intellectual Challenges

- IC1 Learning from Biology: More Pre-processing.
- IC2 Learning from Biology: The Dark Silicon Challenge.
- IC3 Learning from Biology: Massively Parallel Extremely Low Power Processing.
- IC4 From “Always On” To “By Default Off”.
- IC5 Power/Energy Characterization of Processor Designs.
- IC6 Power/Energy Characterization of Software.
- IC7 Parallel Design of Complex Software Systems.
- IC8 Low Power Multi-Voltage Design and Verification.
- IC9 Dynamic Power Control of Mobile Computer Systems.
- IC10 More “Power” to Programmers.
- IC11 Raising Energy Consumption Awareness.
- IC12 Energy Autonomous Robots.
- IC13 Communication vs Computation.
- IC14 Re-evaluating Algorithms for Energy Efficiency.
  - Re-evaluation of Traditional Metrics for Computational Complexity.
- IC15 Education.

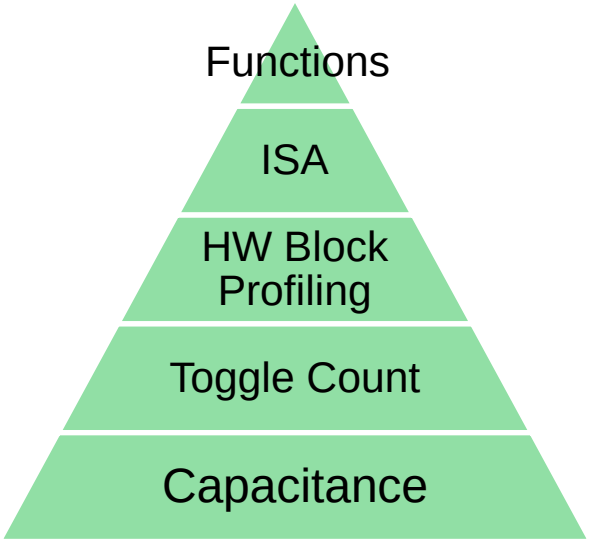
EACO W4 Research Challenges

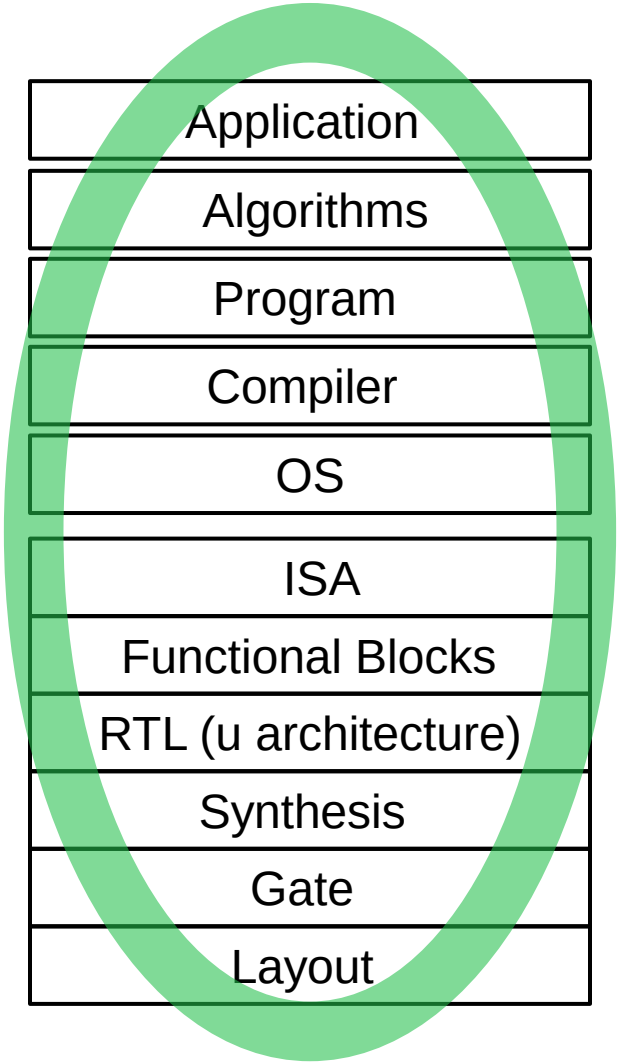
- Compiler/OS-Level Approaches to Energy Efficiency
- Energy Transparency from SW specification to HW implementation
- Identifying the “Limit”: How to bridge the gap between HW and SW?
- Complexity Metrics for Energy Consumption
- Biologically Inspired Methods

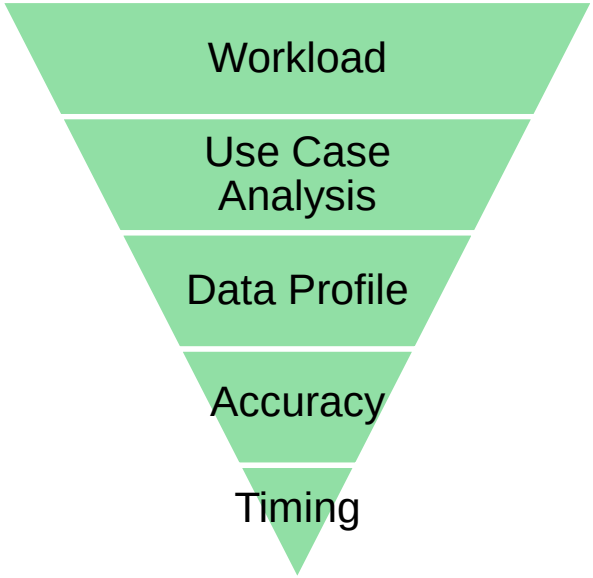
EACO on all Layers in the System Stack

Expose HW properties to enable early system analysis and optimization

HW to SW





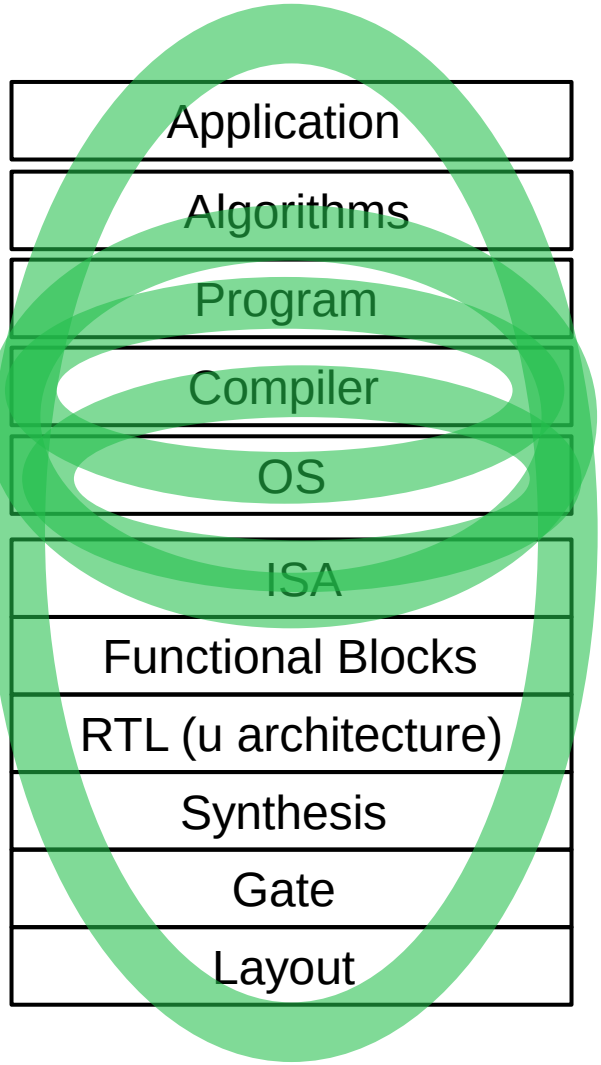


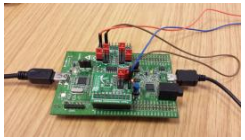
SW to HW

Design system tailored to end user needs

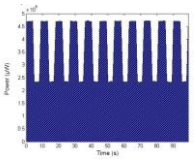
Energy Efficient System

EACO Research at Bristol





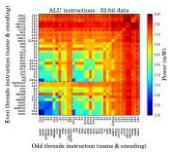
- EACO Platform
  - Online power monitoring
  - RTOS API

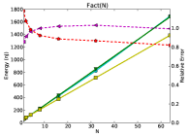


- EACOF (github.com/eacof)
  - Instrumentation of SW

- Machine Guided Energy Efficient Compilation (MAGEEC)

- Whole Systems Energy Transparency (ENTRA)



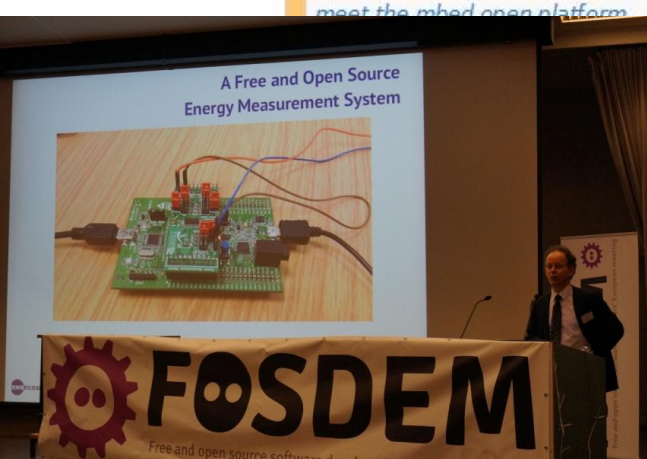


FOSDEM “Who ate my Battery?”

Energy-efficient computing devroom

Room: AW1.126
Calendar: iCal, xCal

Event	Speakers	Start	End
Sunday			
Energy scavenging, battery life and should we build more power stations *Why energy-efficiency of hardware and software matters*	Jeremy Bennett	09:00	09:30
Measuring energy consumption in embedded systems	Simon Hollis	09:30	10:15
An approach for energy consumption analysis of programs using LLVM	Kerstin Eder, Kyriakos Georgiou, Neville Grech	10:15	10:45
spEEDO: Energy Efficiency through Debug suppOrt	David Greaves	10:45	11:45
Open Energy Measurement Hardware	James Pallister	11:45	12:15
Open Low Power Devices *meet the mbed open platform*	Emilio Monti	12:15	12:30



Thank you for your attention

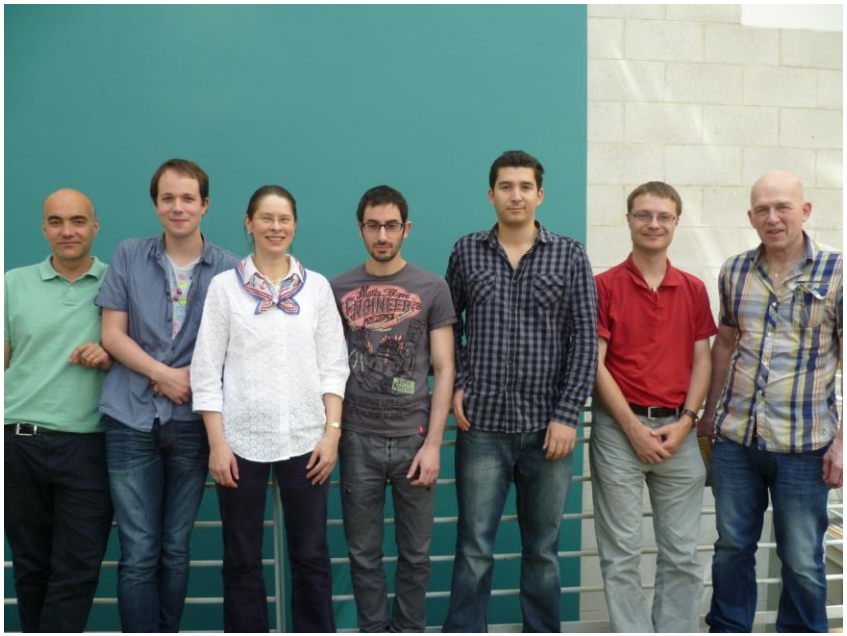
EMBECOSM®

ENTRA
Whole-Systems Energy Transparency

COOPERATION

XMOS®

The Royal Academy of Engineering



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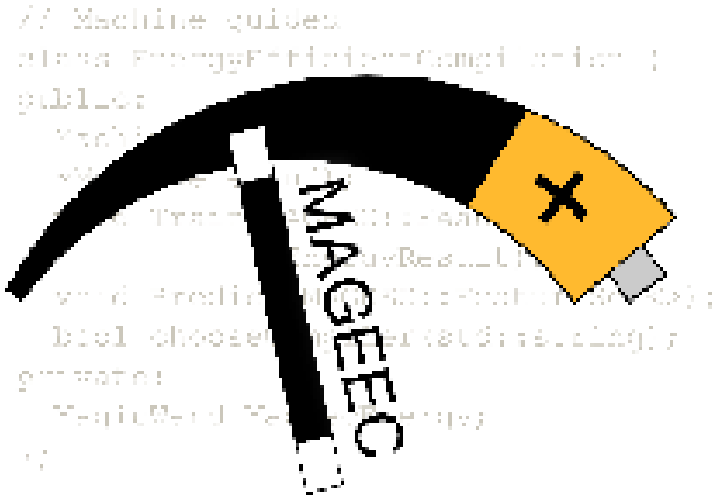


MAGEEC

Machine-Guided Energy-Efficient Compilation

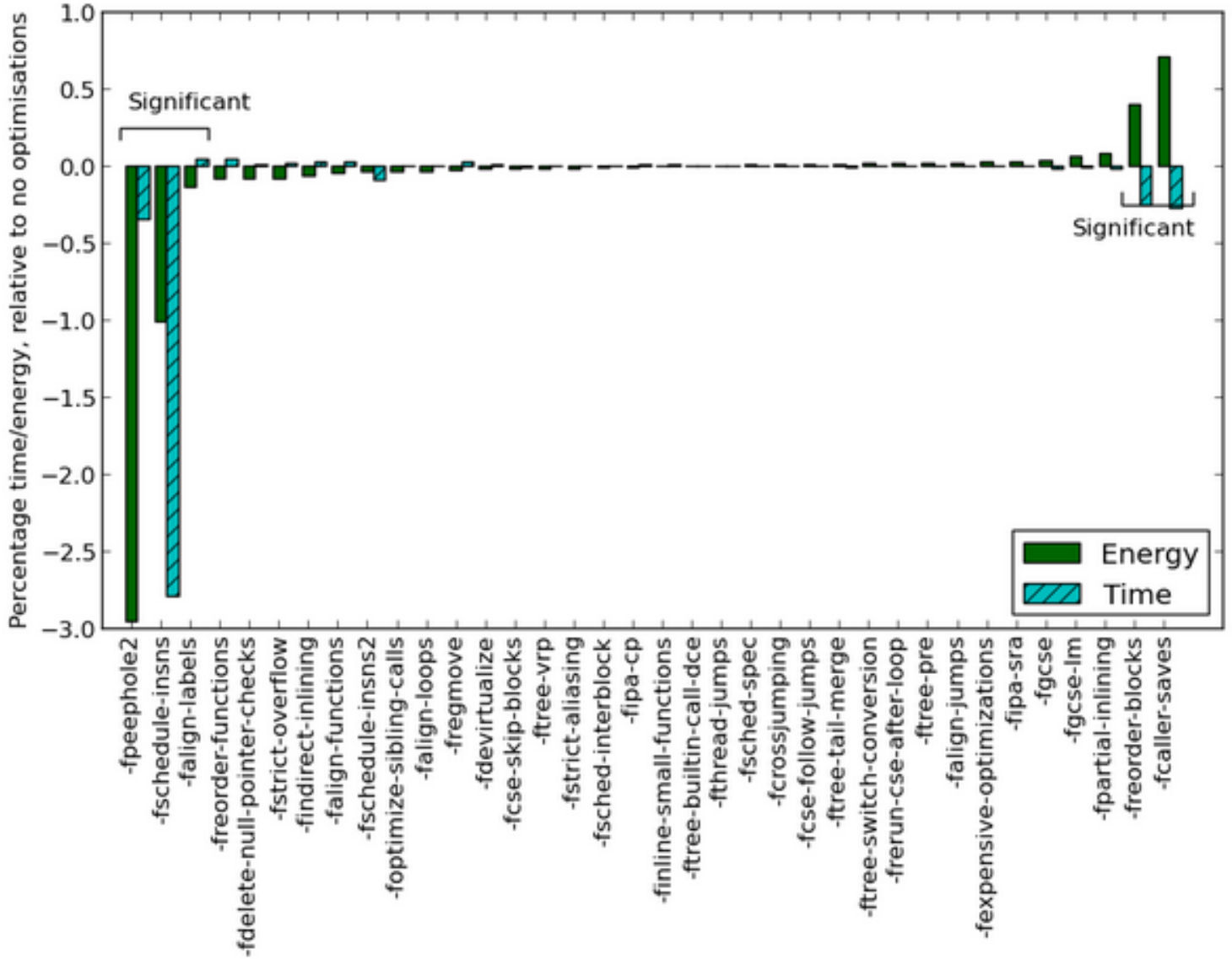
in collaboration with Embecosm Ltd

with funding from the UK TSB

University of BRISTOL

EMBECOSM®

Impact of Compiler Flags



MAGEEC Framework