Hardware & Algorithms

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Disclaimer: 3.5 from (Astro-)particle physicist, 1.5 from industry

Questions

- Which **adaptive measures for hardware and algorithms** could have a decisive impact on ErUM-Data?
- Which types of hardware (including e.g., GPU, TPU, FPGA, neuromorphic computing) could be considered and which **automated mechanisms** exist **for adapting algorithms** to non-specific or dedicated hardware?

Hardware & Algorithms

Specialized hardware

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- GPU, TPU, FPGA
- CPU, SIMD …
- ASICs, ARM64
- Benchmarking
  - Emission tracking (hardware, cooling, energy mix)

Tooling and Compiler

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- Best practices, e.g. compiler flags and usage of current versions
- JIT compilation
- Caching / checkpointing
- Alpaka
- Freezing

Algorithm Adaption

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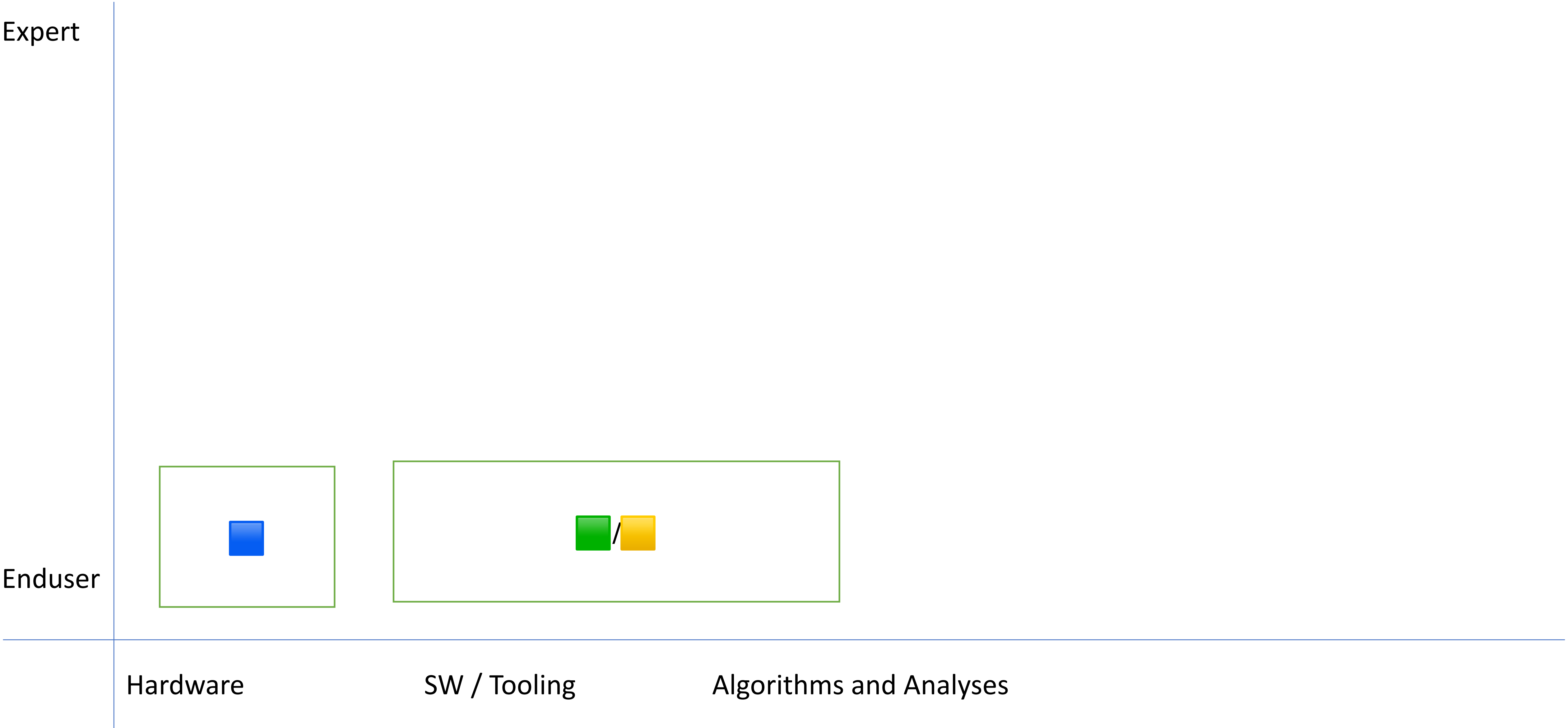
- Teaching (for tools)
- Vectorisation
- Memory management
- Sustainable scheduling

Expert vs. Enduser (current state)



Expert

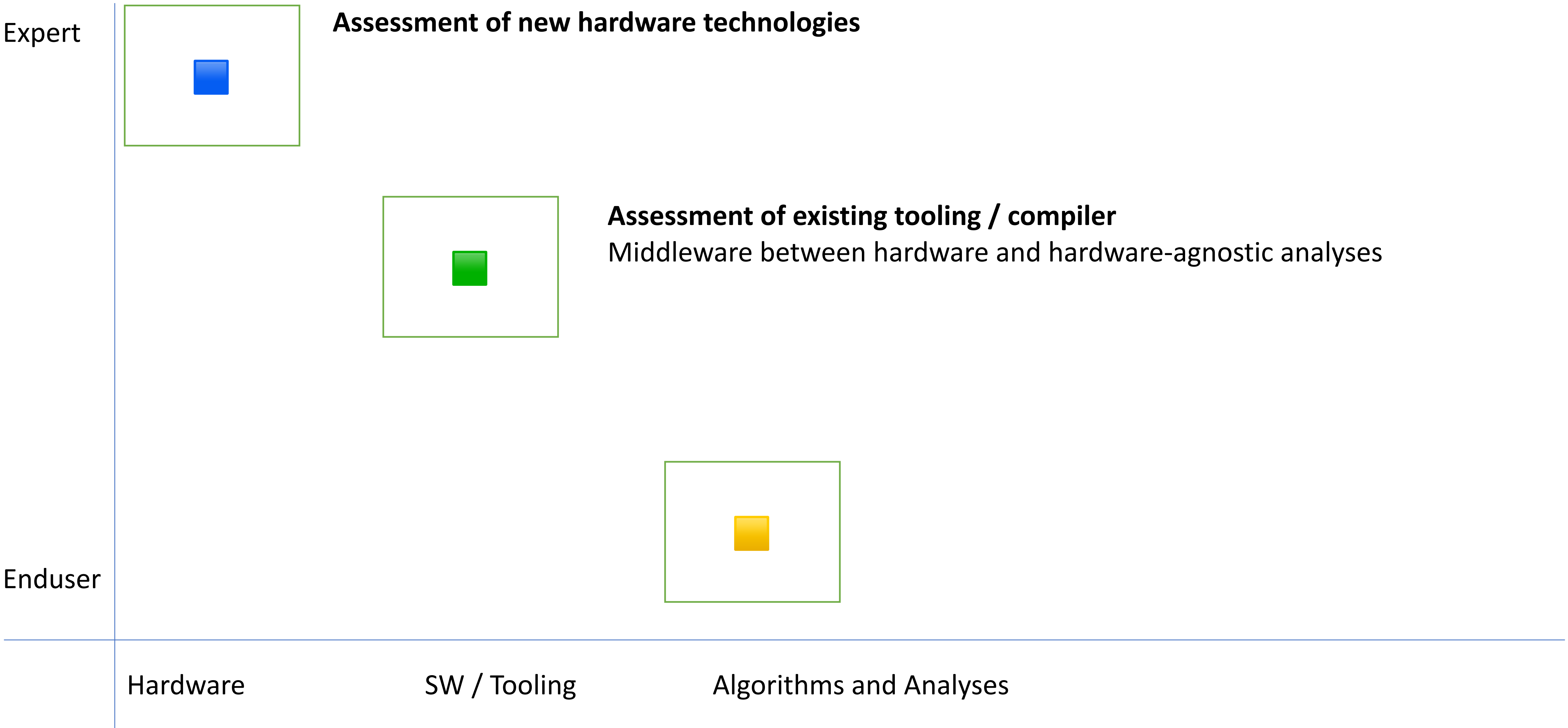
Enduser

Hardware

SW / Tooling

Algorithms and Analyses

Expert vs. Enduser (new state)



Expert

Enduser

Assessment of new hardware technologies

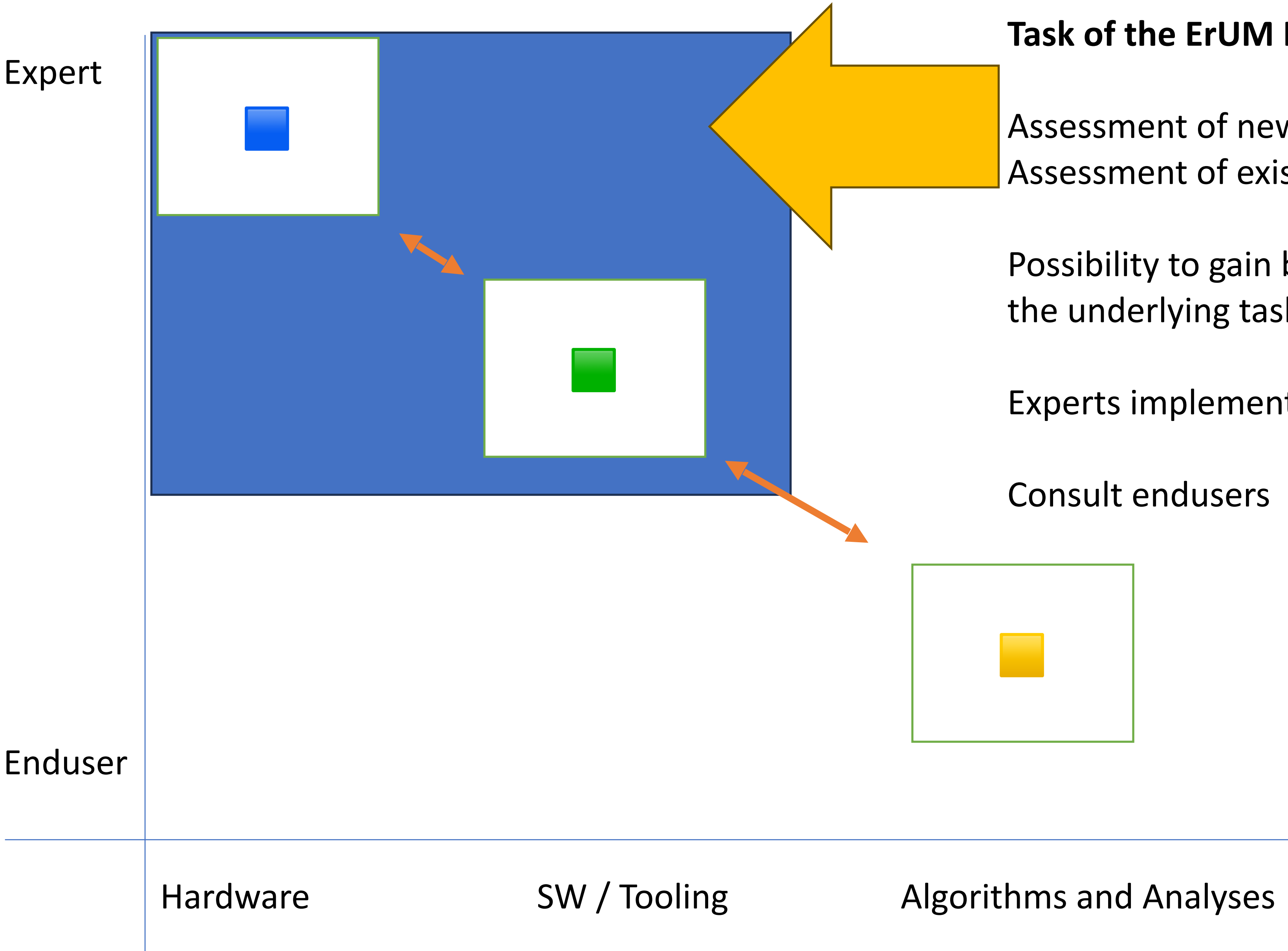
Assessment of existing tooling / compiler
Middleware between hardware and hardware-agnostic analyses

Hardware

SW / Tooling

Algorithms and Analyses

Expert vs. Enduser (new state)



Task of the ErUM Hardware Lab:

Assessment of new hardware technologies
Assessment of existing tooling / compiler

Possibility to gain benefits of energy-optimized hardware for the underlying task

Experts implement (mandatory) online course for SW/tooling

Consult endusers

ErUM Hardware Lab

- Keeps an eye on new hardware developments and assesses the technologies
- Promotes “middleware” tool to communities
- Acts as contact for industry, allows for prototyping with industry
  - Quick and unbureaucratic processes for hardware procurement (e.g. if it is not possible to obtain multiple offers)
- Longterm budget and personnel
- Benefits research and industry, helping them to understand our needs

Other

- Benchmarking of hardware, emission tracking of computing workflows
- Energy-/CO_2-optimizing scheduling
- Provide incentives (and create acceptance for yet another tool) for users to compute sustainably

Summary

- Introduction of ErUM hardware lab for R’n’D and teaching
- Improvement of current scheduling to incorporate CO_2-footprint.
- Optimal usage of existent hardware through benchmarks and efficient (CO_2-)tracking of workflows.