Friedrich-Alexander-Universität
Faculty of Engineering

Ecology-Aware Material Use as a Pervasive Trait in Intermittent Real-Time Systems

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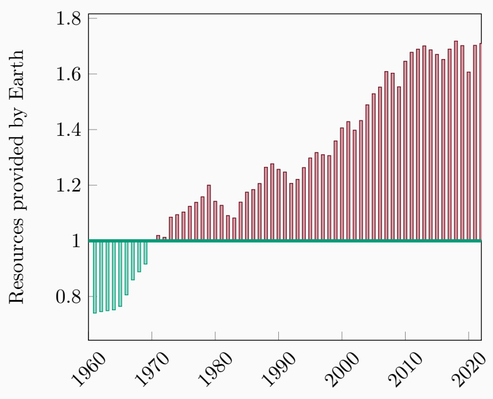
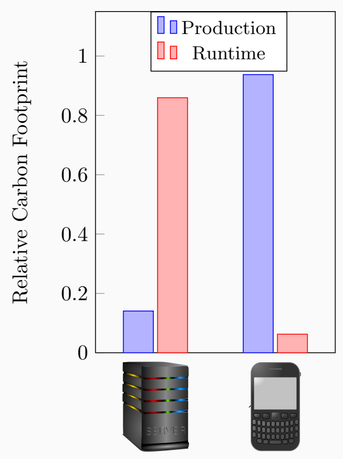
Resource Consumption



Human resource consumption normalized to regenerative biocapacity

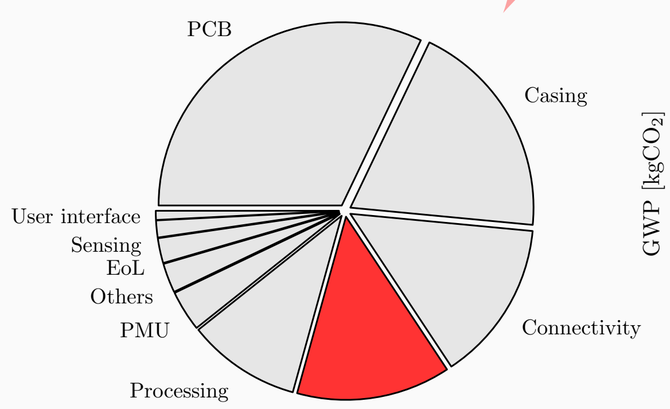
[GFN]

Global Resource Use



[Gupta 2022]

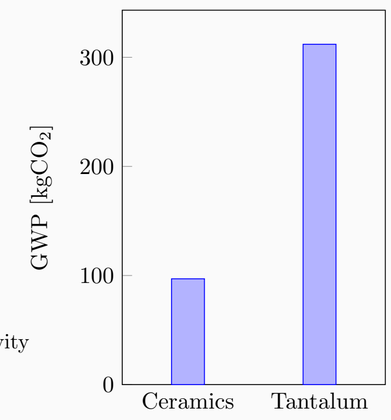
Ecological Footprint



GWP Breakdown of a Mobile Device [kgCO$_2$]

[Maistriaux 2021]

Use Case: Energy Storage



GWP of Capacitor Materials

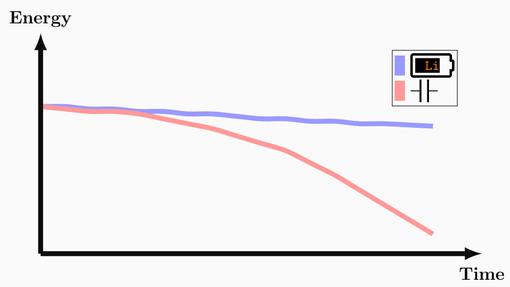
[Smith 2018]

Possible Criteria

- **global warming potential (GWP)**
- ethical concerns
- toxicity
- . . .

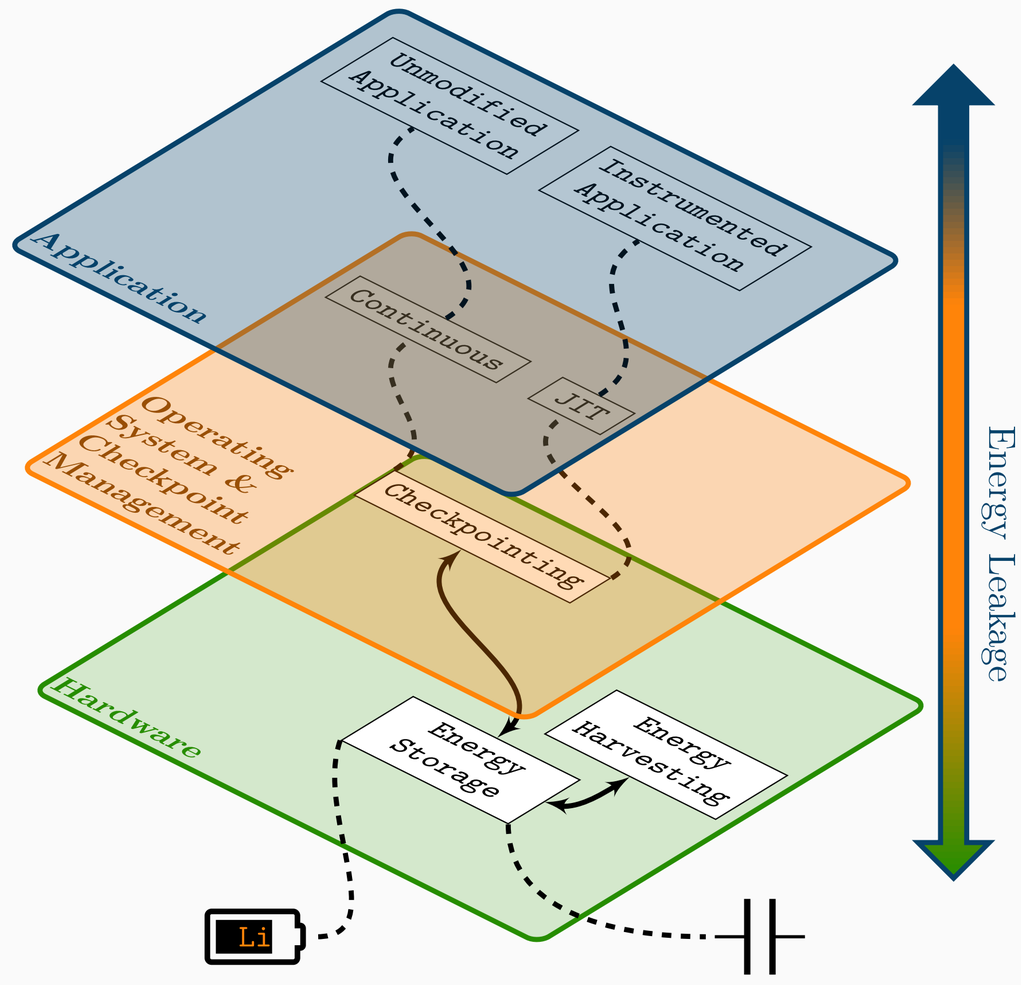
Material Characteristics

Use of Lithium & Energy Leakage



	System-Software Design	Ecological Compatibility
Li	✓	✗
⊣⊢	✗	✓

Crosscutting Through System's Stack



Known Issue in Energy-Harvesting Real-Time Systems

- microarchitecture influence on timing behavior
- interference between the operating system and tasks
- issue of forward progress with intermittent power supply
- soft real-time systems: **forward progress essential**
- high energy leakage complicates forward progress

Outlook & Conclusion

- **ecology as a central design trait**
- consider all resource/material use throughout design process
- **trade-off** between ecology and functionality

References

[GFN] Global Footprint Network, https://data.footprintnetwork.org/#/countryTrends?type=earth&cn=5001

[Maistriaux 2022] Pol Maistriaux et al., *Modeling the Carbon Footprint of Battery-Powered IoT Sensor Nodes for Environmental-Monitoring Applications*, IoT 2022

[Smith 2018] Lucy Smith et al., *Life cycle assessment and environmental profile evaluations of high volumetric efficiency capacitors*, Applied Energy 220 (2018)

[Gupta 2021] Udit Gupta et al., *Chasing Carbon: The Elusive Environmental Footprint of Computing*, HPCA 2021

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