

SEAI National Energy Research, Development & Demonstration Funding Programme

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Harmonic management with AI for EV charging & grid-tied microgeneration

Project Overview/ Background

- EV chargers, solar PV inverters, and battery storage systems inject higher-order **electrical harmonics** into the grid.
- **Harmonics** are distortions that reduce efficiency, risk equipment damage, and increase operating costs.
- Smarter on-site management is required to mitigate the effects of harmonics.

Problem statement

Can AI enable smarter, more efficient EV charging and microgeneration without expensive grid upgrades?

- **Evidence gap:** Irish charging plans track rollout, but HARMONIC-AI focuses on what happens inside sites.
- **Scope:**



Research Methodologies

- Edge harmonic estimation informs EMS schedules.
- Adaptive charging is then tested through hardware-in-the-loop and CPO validation.



Research Outcomes

- Faster and more accurate harmonic edge estimation, within **70 ns**.
- Real-time edge control to reduce harmonic injection that results in **< 5%** Total Harmonic Distortion (THD).
- Including converter impedance and control dynamics changes the harmonic interaction with the network

Policy Recommendations



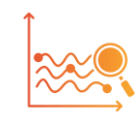
Irish energy market growth



Overcome tech barriers



Access, develop and apply energy RD&D



Software tools for policy makers