

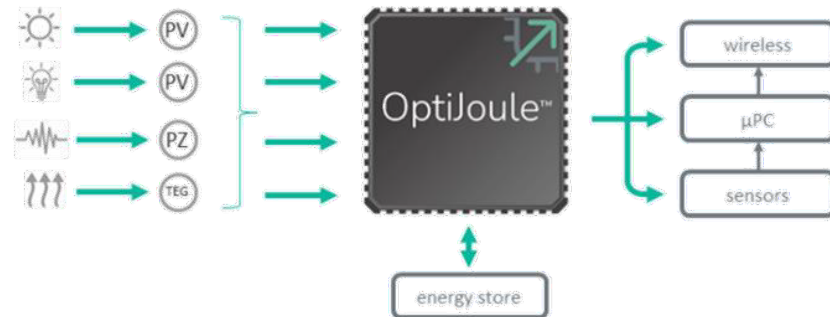
Smarter Energy Harvesting Power Management

Problem

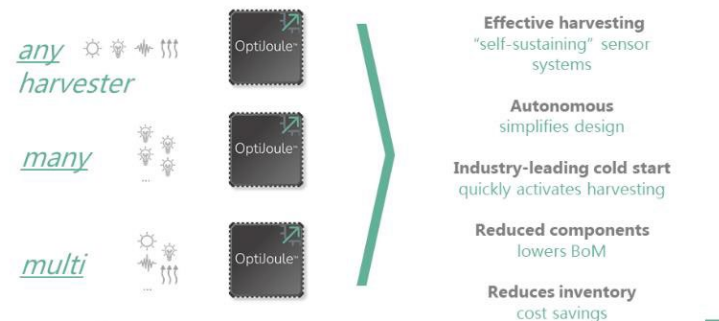
It is forecast that there will be 62 billion connected devices by 2024 rising to 350 billion by 2030. This growth will be driven by a sensor enabled metaverse, the internet of things and edge computing along with industry initiatives such as tiny machine learning (tinyML). The usual definition of tinyML is running machine learning on embedded devices at an average of less than one milliwatt in power. This power requirement is important because it allows unattended devices running on batteries or energy harvesting. If we postulate that half of the 62 billion connected devices will be battery powered, and that of these batteries' half will need to be replaced every year, this equates to 60M battery replacements needed per working day, which is infeasible.

Solution

Micro energy harvesting, and the use of autonomous micro energy sources (AMES) – is seen as an ideal solution to creating self-sustaining wireless sensor and battery-less industrial IoT edge nodes. Along with energy harvesters and energy storage, the key component in an AMES solution is an energy harvesting power management integrated circuit (EH-PMIC).



Trameto has developed OptiJoule technology for its EH-PMIC. Up to four harvesters, of the same or mixed types, can be connected to its inputs, without additional interface components. There is also a version of the power management chip that operates in single-input mode with any one of the harvesters. Uniquely, Trameto's devices adapt autonomously to the type of harvester connected to it. The chip then optimizes its output using patented circuits that dynamically combine the maximum available energy from the harvesters. This allows our customers to design simple, effective and reliable solutions that can harvest energy from a wide range of sources: AC or DC, from nanowatts to milliwatts.



Market Opportunity

The growth in Trameto's market opportunity will be driven by the rapid expansion of a sensor enabled metaverse, the industrial IoT and initiatives such as The Industrial Internet Consortium and Google-led tinyML. Industry experts predict a market opportunity for the industrial IoT of \$71 billion in 2025 with CAGR of 7.8% (ASML Annual Report, 2021). Specifically, In Energy Harvesting: Reaping the Abundant Market, Semico Research forecast that PMIC device sales for micro energy harvesting will grow to 1.2B units (2025) at CAGR 80%. Which will address the opportunity presented by 350 billion of connected devices by 2030. Furthermore, a recent report from IDTechEx Battery Elimination in Electronics: Market Impact IoT, 6G, Healthcare, Wearables 2021-2041 features Trameto and highlights the opportunity for multi-mode energy harvesting. Trameto is predicting revenues of \$15M (2025) rising to \$100M (2030).

Progress to Date

2019

- Euro Commission SME Phase2 grant
- Join Silicon Catalyst

2020

- Mark Ross, ex-CTO Cypress, joins as technology contributor
- Customer demos and taking place

2021

- Fully integrated device taped-out
- Winner Power Systems Product of Year, Elektra Awards

2022

- Closed 'Seed-B' funding from corporate investor, u-blox
- Fully integrated autonomous device & EVKs available
- Rapidly growing number of collaboration agreements

To date, we have designed and developed our first chip as a minimum viable product. Recently we have signed a collaboration agreement to develop a smart energy harvesting evaluation platform with Murata a worldwide leader in electronic solutions and communication modules. We have successfully completed the first phase of this partnership.

Business Model

Trameto is a fabless semiconductor company, selling our device to system integrators within the industrial IoT. Our route to market will use reference designs and is via a blend of direct sales, distribution and manufactures' reps.

Competition

We have identified other suppliers of PMICs including TI, Analog Devices and E-peas. All devices identified are defined, and limited, by their single input harvester capability. Competitor solutions require clumsy and costly work-arounds when used for many and multiple inputs.

Team

- **Huw Davies**, CEO & Founder has held executive and founder positions in the semiconductor industry with companies ranging in size from start-up (Audium – funded by Benchmark Capital) through to multinational corporations (Conexant Systems). Huw has a successful track-record of launching new products into nascent and emerging markets.
- **Laurence Strong**, CPO & Founder is Chief Product Officer and a technical marketing and applications professional with an electronic engineering and design background and over twenty-five years' experience; twenty of these in the semiconductor and consumer electronics industry (XMOS & Audium).
- **Mark Ross**, Advisor has been at the centre of the Silicon Valley business and technology world for years working for companies like Cypress Semiconductor, where he was chief Technology Officer, Cisco Systems, and Sun Microsystems along with several successful start-ups.
- **Silicon Catalyst Incubator**, Trameto is a member of the world's only incubator focused exclusively on semiconductor solutions (incl. IP, MEMs and Sensors). Silicon Catalyst is highly prestigious and helping us accelerate our ideas to prototype, and then onto a path to volume production.

Next Steps

We have closed our Seed-B round, which was jointly led by our existing investors along with funding from u-blox, the provider of wireless chip technologies. We are delivering to customers and partners the next generation evaluation platforms of our OptiJoule products, this integrates the smartest autonomous and adaptive functionality. In turn this enables us to close additional collaboration agreements and secure further design wins. We expect to secure initial purchase orders for our devices in early 2023. At this time, we are interested in talking to potential partners.