Zero Energy Devices ZED: Self-powered and Backscatter-Powered Electronics and Electrics Markets, Technology 2024-2044

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You could call a solar flashlight and an anti-theft tag “zero-energy devices” but the subject is about to take a huge leap forward well beyond these. You can create a billion-dollar business from making the next ZED materials or devices as detailed in the commerclally-oriented 408-page report, “Zero Energy Devices ZED: Self-Powered and Backscatter-Powered Electronics and Electrics Markets, Technology 2024-2044”

Some of the questions answered:

- How can I create a $1 billion ZED business?
- Potential competitors, partners, acquisitions?
- Market and technology roadmap for 2024-2044?
- Technology readiness and potential improvement?
- Appraisal of needs and appropriate technology options?
- Market drivers and forecasts of background parameters?
- Market forecasts by technology and application 2024-2044?
- Deep analysis of research pipeline including 2024 with implications?
- Explanation of trend to “massless energy”, and other structural electronics?
- Battery-free, ultra-low power electronics, non-toxic, non-flammable options emerging?

Dramatic advances ahead

The day is coming when you never recharge your smart watch or phone and, without need for a battery, they last longer than you do. Internet of Things will be more than a cynical renaming of existing wireless technology because the nodes will genuinely become things-collaborating-with-things and they will be affordable, much smaller, lasting decades and deployable in tens of billions year without pollution. The delights of promised 6G Communications in 2030 will be possible only with ZED metasurfaces enhancing the propagation path and it enabling edge-computing client ZED. You will live longer with ZED inside you. There is much more and you only find it in this deeply insightful, up-to-date report that even scopes research in 2024, future needs and technology evolution. The primary author has created several successful high-tech businesses, so the report is realistic, including warnings concerning dead ends and over-promising.

The big picture

The Executive Summary and Conclusions is sufficient in itself. It has 26 pages of easily- understood infograms and roadmaps followed by 65 forecast lines of ZED and allied technologies and applications. Chapter 2 (25 pages) introduces definitions, context and successes so far including the problem of increasing electricity consumption of electronics with the ZED antidote eliminating power consumption and battery issues. See how on-board energy harvesting is being simplified, saving weight, size, cost, failure modes and toxigens. Can ZED halt the increasing demand of electronics for grid-based electricity? ZED route to success with the Internet of Things? Why are ZED sensors a strong emerging need? Importance of flexible, laminar and 2D energy harvesting and sensing , even self-powered and integrated sensors 2024-2044? See how next telecommunications generations deliver more ZED opportunities.

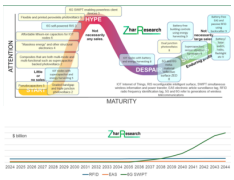
The heart of the report

The heart of the report consists of three chapters on how to address certain important sectors with ZED then seven chapters on the important ZED enabling technologies emerging 2024-2044 to drive your success. Enjoy close examination of the latest research pipeline and realistic timescales and requirements for commercial success with much distilled into new SWOT appraisals, comparison charts and infograms. This is firm analysis of commercial opportunities not academic obscurity, rambling text or nostalgia.

ZED for 6G Communications

6G Communications is planned for 2030, with a radically improved form in 2035. The 49 pages of Chapter 3 address this, highlighting how it will both need widespread ZED in its infrastructure to succeed

Media:



Related Sectors:

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Related Keywords:

ZED :: Zero Energy Devices :: Technology :: Energy Harvesting :: 6g :: SWIPT :: WIET :: Ultra-Low Power Electronics :: Supercapacitors :: Backscatter :: Energy ::

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and it may enable huge numbers of edge computing ZED client devices.

ZED appearing as wireless sensors, IOT, personal and other electronics

Chapter 4 concerns “ZED progress with wireless sensors, IOT, personal and other electronics” so it takes a full 56 pages to interpret such a broad scope of achievements, opportunities and research approaches. The massive scope for vast numbers of fit-and-forget battery-free sensors gets particular attention. Sensor transducers that are their own source of electricity, ZED wearables including metaverse interfacing, ZED in automotive, medical and more – it is all here. Then come the technology chapters with your best opportunities to participate.

Optimal technology strategies

Chapter 5 “Strategies to achieve fit-and-forget battery-free ZED” in 30 pages presents battery headwinds 2024-2044 and ZED enablement, notably eight ZED enablers that can be combined. See self-healing materials for fit-and-forget then useful specification compromises with energy harvesting. Here is a battery-free perpetual micro-robot. Combining these approaches is brought to life with examples of “Batteryless energy harvesting with demand management” , “Quest for battery less ZED in heterogenous cellular networks”, “Wireless sensor networks enable their ZED devices with severe performance compromises”, “Oppo view of zero power communications and “ZED lessons from active RFID”

Energy harvesting system design for ZED

Then comes energy harvesting system design for ZED, the elements of a harvesting system and new infograms on energy harvesting system detail with improvement strategies 2024-2044 and on 13 families of energy harvesting technology considered for ZED 2024-2044 followed by more detail. Again, the approach is critical not evangelistic because companies and researchers vary in their approaches from very realistic in our 20-year timeframe to the extremely speculative and unwanted.

Next ultra-low power electronics makes new ZED feasible

Chapter 6 (39 pages) addresses the contribution to the success of ZED from “Ultra-low power electronics, sensors, and electrics”. It is broad in scope but, because of their great importance, it particularly covers ultra-low power integrated circuits and metamaterials needing much less electricity so your energy harvesting and backscatter power can operate vastly more forms of device.

Backscatter on steroids

Chapter 7 (19 pages) “Powering devices only when interrogated: backscatter, SWIPT, WIET, WPT for EAS, RFID, IOT, 6G Communications and other electronics” then goes really deeply into that form of ZED enablement. This necessarily includes so-called “ambient backscatter communications AmBC”, “crowd-detectable CD-ZED” and much new research. It is followed by three chapters on the all-important energy harvesting technologies evolving for ZED applications.

On-board harvesting options increase and combine

Chapter 8 (23 pages) is “Harvesting electromagnetic waves: photovoltaics to power devices” then Chapter 9 (18 pages) is “9. Harvesting ambient electromagnetic waves: RF harvesting power for devices and communication by recycling existing emissions” and the rest is covered in Chapter 10 (39 pages) “Mechanical harvesting for devices (acoustic, vibration, linear and rotational motion) using electrodynamics, piezoelectrics, triboelectrics etc. Thermoelectrics, pyroelectrics, evaporative hydrovoltaics, microbial fuel cells (biofuel harvesting)”.

However, an aspect rarely addressed is the combination of these many energy harvesting technologies to reduce and sometimes eliminate the need for on-board energy storage to overcome their intermittency and inability to respond to load variations. Consequently, Chapter 11 (16 pages) covers, “Multi-mode energy harvesting for devices” including its progression into single smart materials. See examples such as “thermoelectric with photovoltaic”, “photovoltaic with electrokinetic”, “thermoelectric with photovoltaic and movement harvesting” and “push button harvesting with solar power and intermittency tolerant electronics”. From 2024 and other research, learn how there is much more to come for smart watches through to medical implants.

Storage that batteries can never achieve

At this stage you will realise that many zero energy devices without storage have been presented

throughout the report. You will accept that self-powered devices with long-life batteries can still be considered “ZED”. Nonetheless, it is clear that the big opportunity ahead is where alternatives to on-board batteries are used to cover intermittency of energy harvesting and the need to respond to load variation. Chapter 12 (40 pages) therefore analyses, “Supercapacitors, variants and massless energy for battery-free ZED”. It explains why supercapacitors and lithium-ion capacitors are the prime candidates but it also discusses others with few or none of the problems of batteries such as life, reliability, toxicity and flammability.

Massless energy will transform ZED

They all take more space and weight than a good battery in a ZED but two escape routes are presented. One is wide area thin formats and the other is what Imperial College London calls “massless energy”. Here, a dumb load-bearing structure such as a watch case is replaced with a structural supercapacitor material incurring no increase in space or weight even if it has a photovoltaic overlayer. The report, “Zero Energy Devices ZED: Self-Powered and Backscatter-Powered Electronics and Electrics Markets, Technology 2024-2044” is your essential guide to this large new ZED opportunity.

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