

# Something From Nothing: An Evaluation of Vacuum Energy Extraction Methods

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Over the last two decades several patents and research papers have reported purported practical methods to extract useful energy from the vacuum. I describe the inventions and analyze the underlying physics. From an analysis based on first principles it is clear that most of the inventions have fundamental errors and cannot work. The basic concept of harvesting zero-point energy remains viable, and at least one patented concept might work.

The vacuum is filled with a high density of zero-point energy, in the form of modes (vibrational patterns) of electromagnetic field. Over the last eight decades it has become clear that this zero-point field (ZPF) vacuum energy is not simply a mathematical formalism, but produces demonstrable effects on physical systems. Along with that realization has come the desire to extract energy from the ZPF.

One set of methods use nonlinear elements to convert the ZPF into a usable form. A rectifier (used to convert AC to DC) is a strongly nonlinear element. One patent makes use of antennas to capture the ZPF. This energy is then rectified and used. Another set of inventions simply rectify fluctuations (noise) in electronic elements as an extraction method. Using a detailed balance argument, I show that these methods cannot work.

Another set of patents describe using a Casimir cavity to mechanically extract energy from the ZPF. A Casimir cavity consists of two closely spaced reflecting plates that exclude ZPF electromagnetic modes having wavelengths larger than twice the gap spacing. The result is that the imbalance in the density of the ZPF inside and outside the cavity causes the plates to be attracted to each other. This attractive potential can be used, but only once. To produce power continuously, a method must be devised to form a reciprocating Casimir engine. The patents purport to switch off the Casimir attraction while the plates are pulled apart, so that they can repeatedly accelerate together and produce power. This approach is shown to be fundamentally flawed, and cannot produce power continuously.

A recently issued patent describes a method by which vacuum energy is extracted from gas flowing through a Casimir cavity. According to stochastic electrodynamics, the electronic orbitals in atoms are supported by ambient ZPF. When the gas atoms are pumped into a Casimir cavity, where long-wavelength ZPF modes are excluded, the electrons spin down into lower orbitals, releasing energy. This energy is harvested in a local absorber. When the electrons exit the Casimir cavity, they are re-energized to their original orbitals by the ambient ZPF. The process is repeated to produce continuous power. This method does not suffer from the fundamental flaws of the other approaches, and might work.