

# Piezoelectric Systems for Sheikh Zayed Road

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## Situation

- UAE was ranked as 37 worldwide according to the amount of electricity consumption with an annual consumption of 70.58 billion KWh [1]
- The total cost of producing that amount of electricity has been estimated to be 11.33 billion dollars [2]
- Since the last decade, the UAE's electricity demand has been increasing exponentially, as shown in Figure 1
- Abu Dhabi water and electricity company (ADWEC) expects that the electricity demand is going to grow by 15% annually till 2015 [3]

United Arab Emirates, Electricity consumption per capita

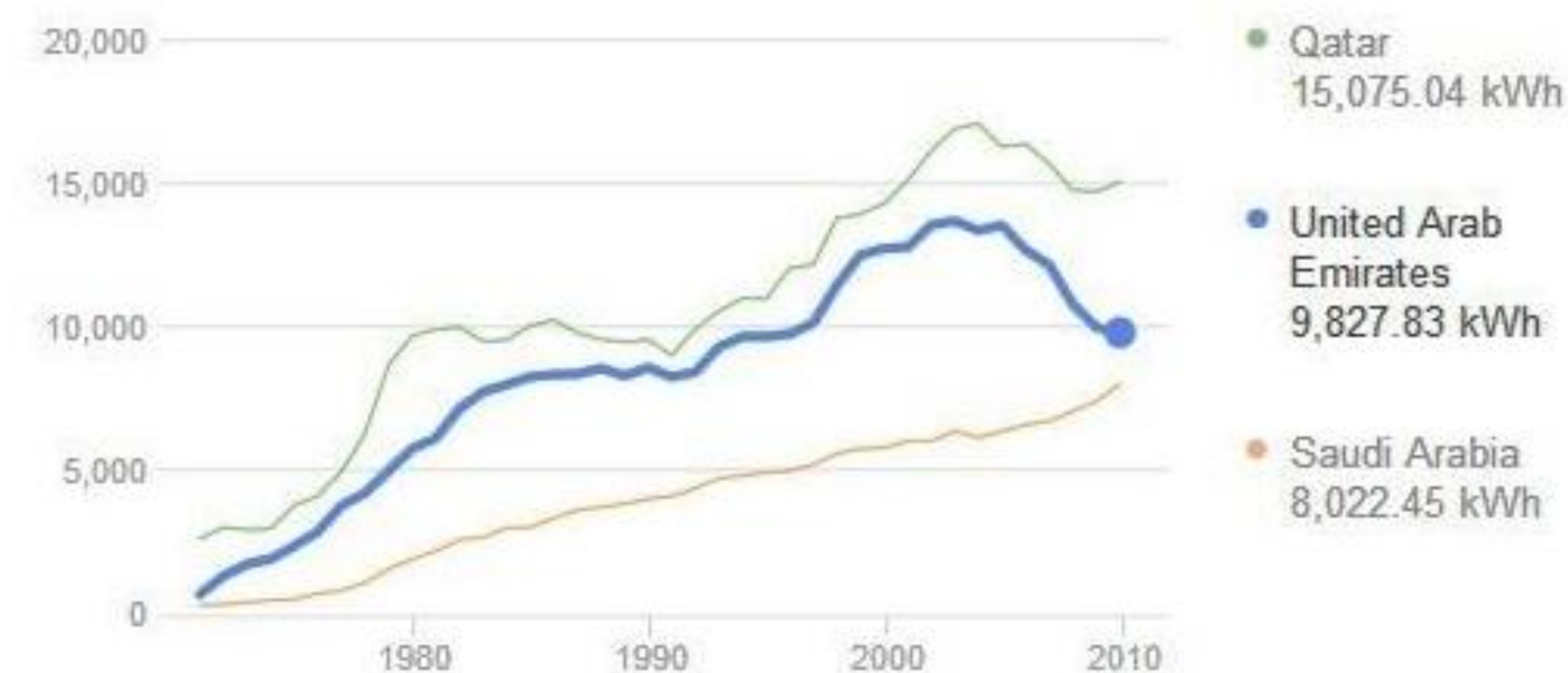


Figure 1: UAE's electricity consumption per capita (Credits - <http://www.worldbank.org>)

## Problems

- Massive amount of natural gas is consumed for electricity generation
- UAE's energy consumption rate per person is one of the highest in the world
- The use of long power lines can result in power losses as well as economical losses for maintenance
- Power plants need large areas of land
- UAE has the highest carbon footprint per capita in the world

## Solution

To solve these problems and help satisfy the increasing energy demand we propose using piezoelectric technology on roads.

### Piezoelectric System :

Piezoelectricity is generated by using piezoelectric crystals that are present in the piezoelectric generators. These generators are embedded 5-6 centimeters below asphalt, concrete or composite concrete roads and deform slightly when pressure is applied on them. These deformations result in electric current. The generators are connected either to the battery that stores the electrical energy for later use or directly to the main grid [4].

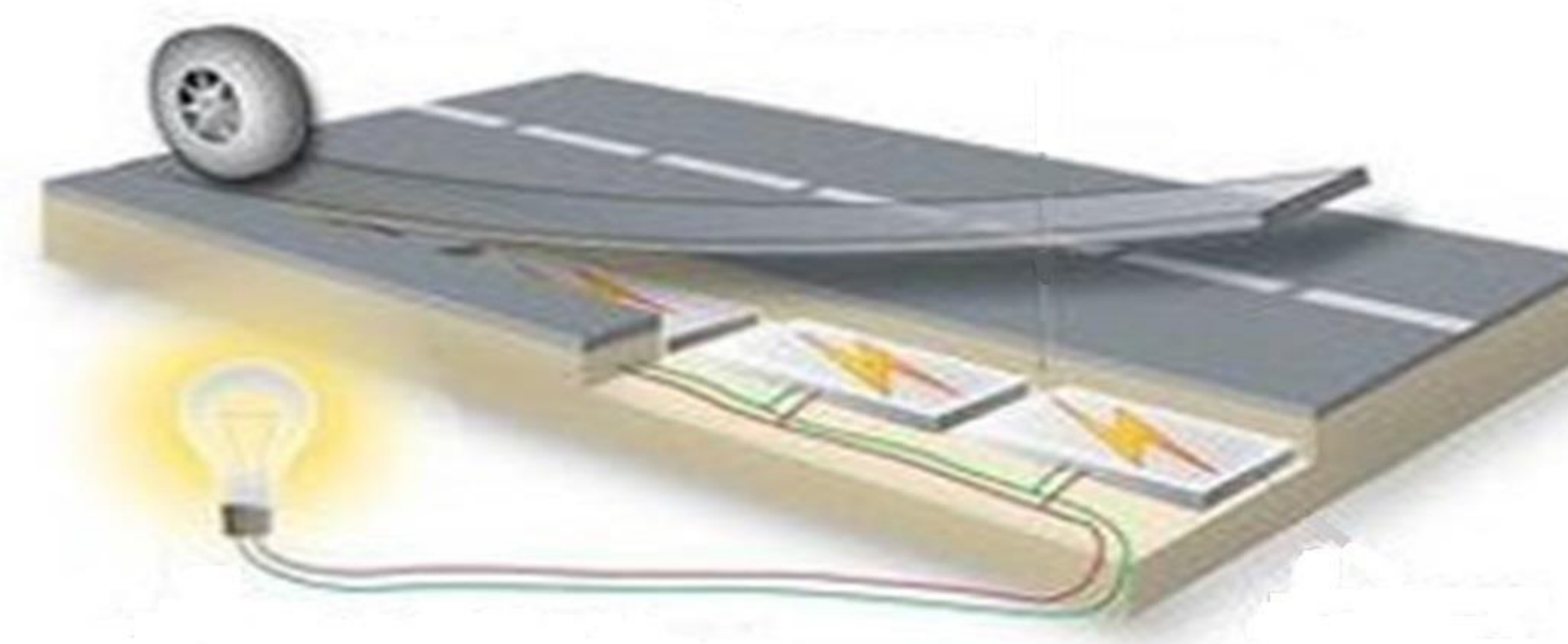


Figure 2: Piezoelectric System (Credits - <http://www.utwente.nl>)

### Energy Storage:

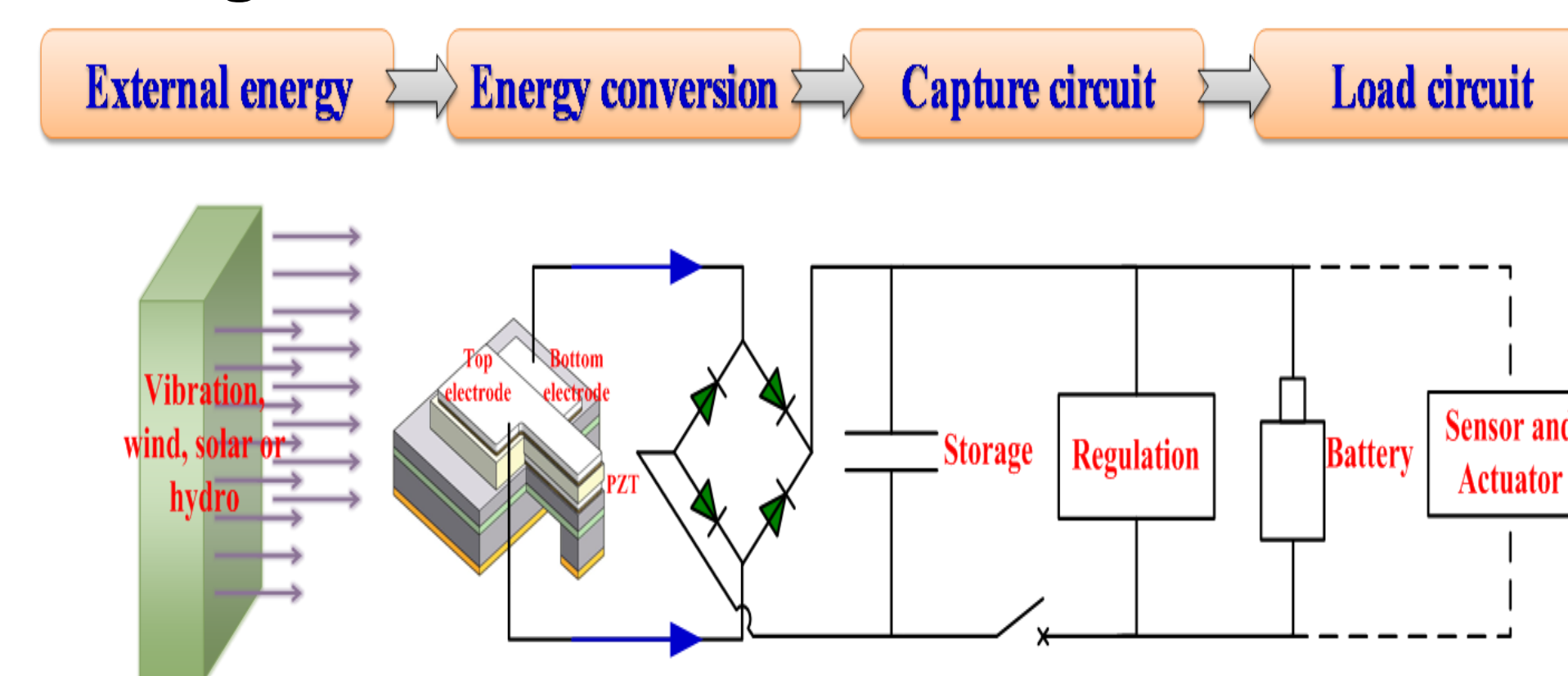


Figure 4: Energy storage system diagram (Credits - <http://www.intechopen.com>)

Converting non-uniform voltage pulses due to an expected traffic conditions.

### Components of the Circuit:

1. Rectifier: is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction
2. Super capacitor
3. Regulator: is an electrical device that is designed to help the circuit maintain a constant voltage level

## Evaluation

### Solar vs. Piezoelectric:

Dubai needs to install US\$100 million worth of solar panels to meet its renewable energy target for Expo 2020. Around 200,000 solar panels that are capable of producing up to 50 MW of electricity to meet the emirate's aim of meeting 50 per cent of the expo 2020 electricity consumption [5]. On the other hand, in California, USA, experiments are being conducted and astonishing results were obtained, stating that the electrical energy produced can reach up to 44 MW annually [6]. Similar results were also obtained from experiments conducted in Haifa, Israel [7]. It is clear that the UAE is interested in alternative energy sources, and a comparison of these two sources is to be made based on:

- Cost
- Energy Generation
- Dependent factors

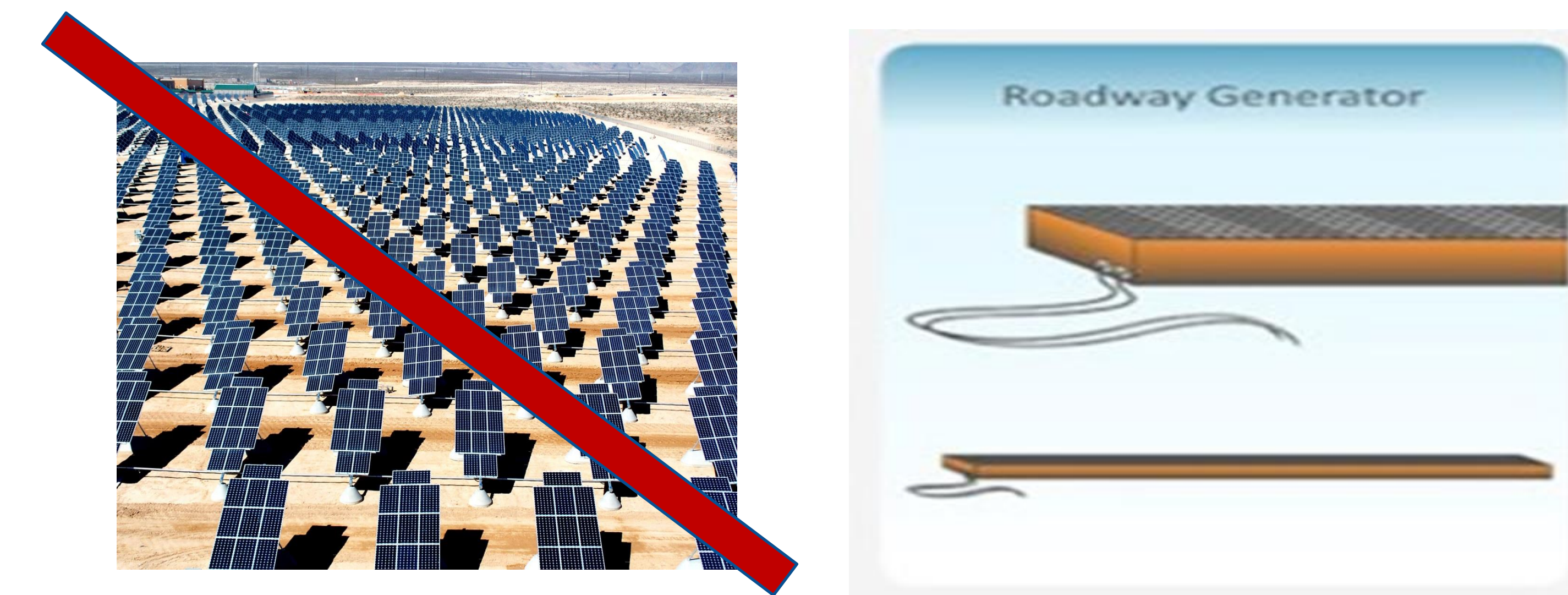


Figure 5: Roadway Piezoelectric System vs. Solar system (Credits - <http://www.treehugger.com>)

## References

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- [7] O. Sandru. (2009, October 6). Israel Highway Equipped With Pilot Piezoelectric Generator System [Online]. Available: <http://www.greenoptimistic.com/2009/10/06/israel-piezoelectric-highway/#.U112UifYHow>