

Recovering “Waste” from “WTEs”? Heat Attaching devices to flues and exhaust pipes could harvest waste heat-

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HERE is a thought: approximately 60% of the energy converted in power generation is wasted. The price of energy is high, both in terms of the actual cost to the consumer and the consequences of the climate change that generating power from fossil fuels causes. If even a small proportion of this wasted heat could be converted to useful power, it would be a good thing.

At this week's meeting of the American Physical Society, in Baltimore, Mercuri Kanatzidis of Michigan State University proposed such a scheme. He advocates attaching thermoelectric devices that convert heat into electricity to chimney stacks and vehicle exhausts, to squeeze more useful energy from power generation.

The technology to do so has existed for years. If one end of an electrical conductor is heated while the other is kept cool, a small voltage is created between the two. Placing two dissimilar metals, or other electrically conductive materials, in contact with each other and then heating them also generates a voltage. Such devices, called thermocouples, are nowadays usually made using semiconductors. They are widely used as thermometers. But if they could be made cheaper, or more efficient, or both, they could also be employed to generate power.

Dr Kanatzidis is developing new thermoelectric materials designed to be capable of converting up to 20% of the heat that would otherwise be wasted into useful electricity. The challenge lies in finding a substance that conducts electricity well and heat badly. These two properties define what physicists call the “figure of merit” of a thermoelectric substance, which describes the power a device made of that substance could generate. Dr Kanatzidis's group aims to make materials with higher figures of merit than those attainable with today's semiconductors.

Since the electrical properties of solids depend on their crystal structures, his group is experimenting with new atomic lattices. In particular, they are working on a group of chemicals called chalcogenides. These are compounds of oxygen, sulphur, selenium and tellurium that are thought to be particularly suitable for thermoelectric applications because their structure allows electric currents to flow while blocking thermal currents. They thus have a high figure of merit. Dr Kanatzidis's group is developing new ways of making these compounds crystallise correctly.

But even existing devices could become economically useful as fuel prices rise, Dr Kanatzidis argues. In America, transport accounts for a quarter of the energy used. Fitting small thermoelectric devices to the exhaust pipes of vehicles could squeeze another 10% from the fuel saving that would be especially relevant in hybrid petrol/electric devices where the battery is recharged in part by recycling energy that would otherwise be dissipated by energy-draining activities such as braking. Similarly, attaching

thermoelectric devices to the flues of power plants could generate more useful power.

And thermoelectric devices could be used in other areas. They could work alongside solar cells and solar heating systems. They could also be used in geothermal and nuclear power plants. Dr Kanatzidis argues that wherever heat is generated as part of power generation, thermoelectric devices could help extract more useful energy. Waste not, want not.