

## Computing for free

According to Environmental Protection Agency's (EPA) to the US Congress report in 2007, the energy used by servers and data centres in the States is estimated to be about 61 billion kilowatt-hours (kWh) in 2006 (1.5% of total U.S. electricity consumption) for a total electricity cost of about \$4.5 billion. This estimate includes neither office nor private PCs but is evaluated to be somewhat higher than the electricity consumed by all colour televisions in the States. EPA also estimated the energy use of servers and data centres in 2006 to be more than double the electricity that was consumed for this purpose in 2000 and that the power and cooling infrastructure that supports IT equipment in data centres also uses significant energy, accounting for 50 percent of the total consumption of data centres. Taken together servers and data centres together with their infrastructure in 2006 spent 2.25 of total U.S. electricity consumption. Similar statistics are available for Europe.

When we go down to 1 electron per bit in the miniturization of transistors we are tempted to expect a reduction in the dissipated heat but that is not to be. Erasure of each bit of information costs us  $kT \ln 2$  Joules. Reversible and quantum computers partly avoid this dissipation though. However, reversible computers are slow and quantum ones have huge problems with the coherence time. We shall therefore consider whether we can further reduce transfer of energy to computing qubits and therefore extend their coherence time. We consider a complete removal of energy transfer to qubits while handling and controlling them by means of interaction-free gates. Reversible computers can then be use to handle external ancillas that issue interaction-free preparation of computing qubits.