New solar-powered tractor to reduce agricultural emissions

Modern agriculture is heavily dependent on fossil fuels. A recent study suggests a solar-powered, agricultural electric vehicle, the ‘Multi-purpose Solar Tractor’, could avert 23.3 tonnes of greenhouse gases every year, compared to a conventional vehicle. The vehicles will be particularly suitable for Mediterranean countries where sunlight is plentiful.

Tractors are typically diesel-powered, contributing not only to global warming and air pollution, but also soil and groundwater pollution through diesel spills. The researchers suggest electric vehicles powered by renewable energy are the answer. Electric vehicles with on-board batteries are simple, comparatively cheap, have low levels of emissions and the technology is available now.

The researchers, working under the EU RAMseS Project¹, have produced a complete energy system for farmers. The system consists of a bank of photovoltaic modules to provide renewable energy, a multipurpose, battery-powered tractor, capable of doing the work of a conventional light tractor up to 40 horsepower (hp), and a set of batteries to store energy. As well as powering the tractor, the energy can be used around the farm or sold to the electricity grid.

The tractor is a light truck with sixteen on-board lead acid batteries powered by a 12kW electric motor. The batteries are charged with power from the 10 kWp photovoltaic modules. The vehicle can transport a load of up to 1 tonne; it agricultural equipment can be attached for watering, pesticide spraying and collecting crops and has a top speed of about 45 km/h on the road. It is especially suitable for work in large greenhouses where exhaust fumes from a standard combustion vehicle are a problem.

Using life-cycle analysis, from acquisition of raw materials through to the end of life, researchers compared the environmental impact of the RAMseS system with that of a commonly used light tractor (29.5 hp) with an internal combustion engine. The researchers considered six GHGs grouped together as CO₂eq, heavy metals and other pollutants, including nitrogen oxides and particulate matter.

The results suggest that the system will release 57.16 tonnes of CO₂eq during an assumed lifespan of 30 years. In comparison, the standard tractor would emit 757 tonnes over the same period. The electric vehicle was also cleaner, producing 2.6 times fewer of the other pollutants. However, lead emissions are a problem. Overall, 73 per cent of all emissions from the RAMseS system relate to the batteries, which emit around 20 tonnes of lead. Improved battery technology could significantly cut emissions and reduce health and environmental impact.

When converted into monetary terms, the lifetime cost of pollution from the internal combustion engine vehicle was 4.7 times greater than from the RAMseS system. (EUR 49,361 compared with EUR 10,407). This is calculated in terms of 1) mortality and human suffering, 2) social and environmental costs and 3) premature deaths from air pollution.

A prototype of the whole system has been assembled for testing at an olive farm in Lebanon, where the solar radiation for the photovoltaic modules is suitably high. A fully developed system would include a number of vehicles. At the moment, diesel fuel would have to cost about EUR 1.50 per litre for the Multi-purpose Solar Tractor to have a cheaper 30 year lifetime cost than that of a diesel-powered tractor², but future grid storage rather than stationary batteries should bring the costs down.

1. RAMseS (Renewable Energy Agricultural Multipurpose System for Farmers) was supported by the European Commission under the Sixth Framework Programme. See: www.ec-ramses.org
2. See: http://europe.theoildrum.com/node/4606

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