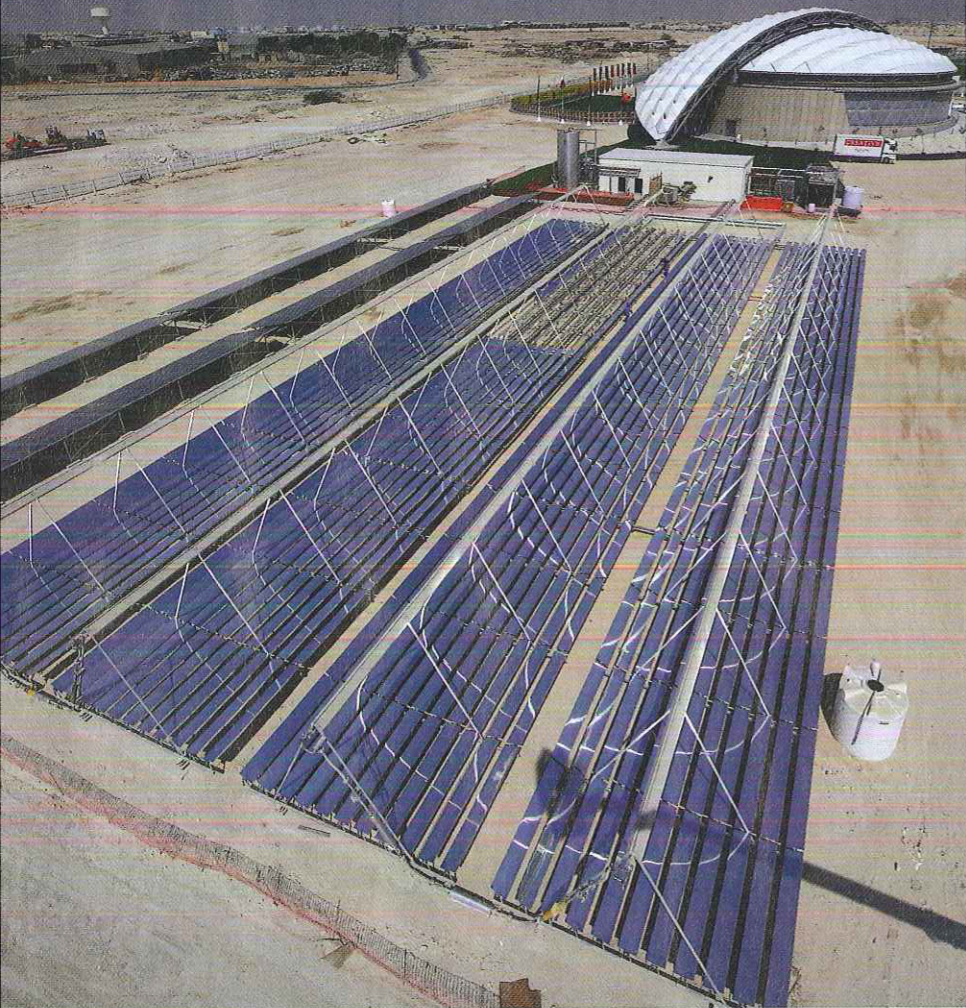


The mini-stadium requires extensive solar arrays to power its ice-making system



© It's always nerve-racking when a prototype building is switched on for the first time a couple of days before officials turn up, says Beaven, but it worked, and the visitors were interested in the technology. "They know these are challenging conditions ... and the stadium did exactly what it needed to do." Outside temperatures had reached 44°C only two hours earlier, but the temperature on the pitch was 23°C.

The big question is: can this be scaled up to meet the demands of a World Cup? Qatar's plan is to build 12 carbon neutral stadiums. Most will have a capacity of between 40,000 and 50,000, with Foster + Partners' larger Lusail Iconic stadium reserved for the opening match and final.

Although the stadiums are carbon neutral in terms of their operation, they hold a great amount of embodied energy – a situation exacerbated by the need to import most of the construction materials. To help tackle this, Qatar's plan is for the upper tiers of nine of these facilities to be removed after the games, which will halve their capacity. These structures will then be shipped to developing countries to create new venues. One stadium will be completely modular and will be deconstructed after the event.

Beaven does not foresee any technical challenges when it comes to upscaling the energy systems. The main change would be to replace the water in the solar cooling system with oil, which can rise to higher temperatures and so store more energy, which could be used to drive a steam turbine to power the chillers. This is a more complicated set up but it would offer greater efficiencies and allow for a smaller solar thermal array.

This is important, because even the mini-stadium's array takes up twice as much space as it does. A 50,000-seat stadium would need a vast area. Beaven argues that given the vast areas of empty desert in Watar, space isn't an issue; he adds that there is the potential to incorporate an element of the solar array onto the roof of the stadiums, although how this would work with an opening roof has yet to be explored.

The showcase has now been handed over to the Qatar Science and Technology Park for further testing. The aim is to work out how the technology can best be integrated into the designs for the new stadiums, and even how they can be used in any arid climate.

Beaven also believes it could be a catalyst for change, especially if Qatar gets the nod for 2022. "It's an exemplar of what is possible and is emblematic of green power in arid regions," he says. "It breaks the rules and because of its high profile it could have an impact on many other developments, not just in the Middle East but around the world."

## KICKING UP A DUST STORM

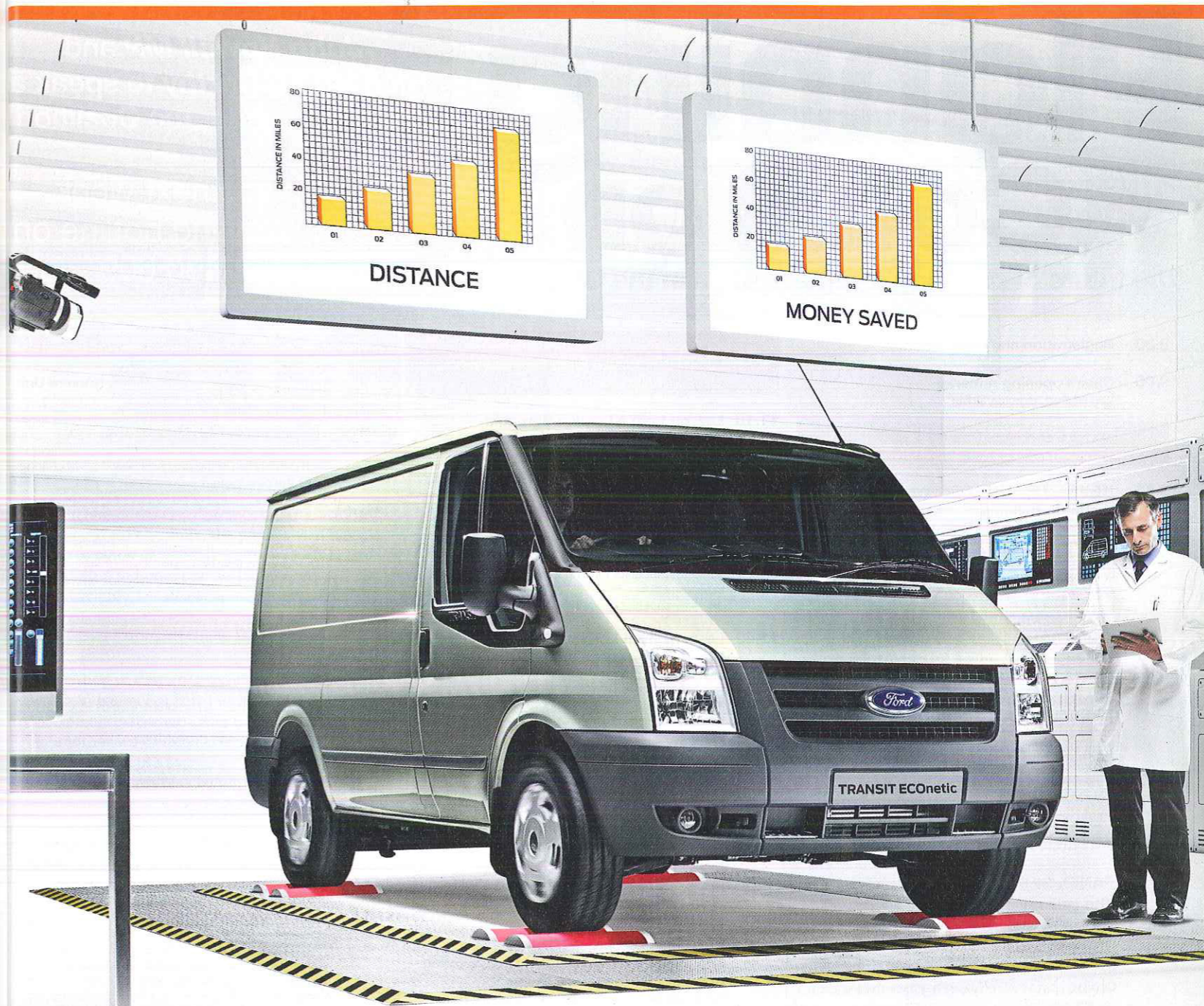


Even if all 12 of Qatar's planned stadiums are carbon neutral in terms of the energy used to run them, is it really sensible to be developing in such a harsh climate? Mike Beaven of Arup Associates argues that it is justifiable and could have wider benefits for other countries. "People worry about building in hot climates but don't worry about building in cold climates where you have to heat the building for eight months of the year.

"In Scandinavia they use a lot of energy but they generate it sustainably using hydroelectric power so nobody raises an eyebrow. There is this thing about development in cities in the Middle East that require cooling and water treatment, but if the energy source can be zero carbon, what's the problem?"

Nor, argues Beaven, do people see a problem with the mechanically cooled stadiums built in the US or building in hot climates such as Arizona or Las Vegas.

It's also ironic that countries that have got rich from oil are using it to develop sustainable technologies. This is a positive step, says Beaven. "It is something that is taking forward technologies both for countries in the Middle East and the world."



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