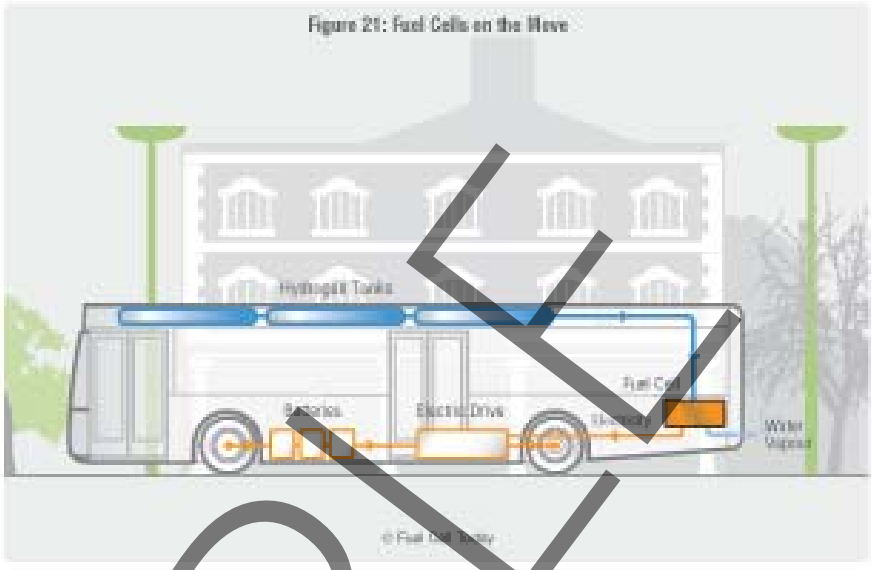
More so than with light duty vehicles, fuel cell buses will be competing against other low emissions and fuel efficient technologies, such as CNG or hybrids, as the transit bus market tends to be an early adopter of clean fuels due to its high public profile and, in certain regions of the world, reliance on public funding. In consequence, key drivers for fuel cells are likely to be not only lower emissions but also noise pollution reduction in densely populated areas and city centres. For cities which desire zero emission and low noise operation fuel cells may be competing against electric trolley systems; in this case, the driver will be cost competitiveness and the avoidance of electric infrastructure.

Figure 21: Fuel Cells on the Move



A key driver for fuel cells is noise pollution reduction.

Materials Handling

Materials handling vehicles are yet another transport application employing PEMs operating on direct hydrogen. The only exceptions are initiatives by Oorja Protonics and Jülich to develop DMFCs for the materials handling market, mainly as APUs on battery forklifts; discussion of this application can be found below in the APU section. Jülich is reportedly also looking at DMFCs for primary power, although given the low peak power of current DMFC technology, this would only be applicable in a narrow segment of the forklift market and in any case Jülich's technology is still largely in the R&D phase. Consequently, this discussion focuses solely on pure hydrogen PEM materials handling vehicles – meaning that, as with LDVs and buses, the point-of-use emissions are zero. While zero emission operation is desirable and indeed mandatory in many indoor distribution centres, warehouse operators already have a zero emission option with battery forklifts. The driver for fuel cell forklifts is therefore not so much the emissions benefits but rather the potential productivity gains of fuel cells over battery powered forklifts.

The driver for fuel cell forklifts is not so much emissions but potential productivity gains.

Fuel cells for materials handling range in power from as little as 4.4 kW up to 30 kW, depending on the class of vehicle. As with LDVs and buses, these systems are hybridised, with a battery providing power for acceleration from a standstill. In terms of system efficiency, a recent analysis by US DOE's Argonne National Laboratory estimated combined fuel cell and powertrain efficiency for forklifts at around 45%, with the fuel cell achieving 56% efficiency.

Trains

Fuel cell systems to power trains are still in very early-stage R&D. This is the last of the transport applications discussed in this section that is the sole province of PEM fuel cells with direct hydrogen, so again fuel cell trains would offer zero in-use emissions. Nevertheless, interest in this sector has slowed considerably and there is only one recent project testing out fuel cells on a locomotive. Vehicle Projects LLC and Burlington Northern Santa Fe (BNSF) are preparing to test a 1.2 MW fuel cell battery hybrid powered locomotive. The locomotive has hydrogen stored onboard in tanks and features a hybrid drive with fuel cell stacks and