Preface

The stage is now reached when the transition from low-volume to high-volume manufacture of fuel cells is imminent and after an intense period of value engineering, suppliers are moving towards affordable stacks for automotive propulsion purposes. Since this book went to press, the automotive application of fuel cells for pilot-production vehicles has proceeded apace, with Daewoo, as an example, investing $5.9 million in a fuel-cell powered vehicle based on the Rezzo minivan, for which it is developing a methanol reforming system. Honda has also made an important advance with version 3 of its FCX fuel-cell vehicle, using a Ballard cell-stack and an ultracapacitor to boost acceleration. Its electric motor now weighs 25% less and develops 25% more power and start-up time has been reduced from 10 minutes to 10 seconds. Ballard have introduced the Mk900 fuel cell now developing 75 kW (50% up on the preceding model). Weight has decreased and power density increased, each by 30%, while size has dropped by 50%. The factory is to produce this stack in much higher volumes than its predecessor. While GM are following the environmentally-unfriendly route of reformed gasoline for obtaining hydrogen fuel, Daimler Chrysler are plumping for the methanol route, with the future option of fuel production from renewables; they are now heading for a market entry with this technology, according to press reports.

A recent DaimlerChrysler press release describes the latest NECAR, with new Ballard Stack, which is described in its earlier Phase 4 form in Chapter 5, pp. 139–140. NECAR 5 has now become a methanol-powered fuel cell vehicle suitable for normal practical use. The environmentally friendly vehicle reaches speeds of more than 150 kilometres per hour and the entire fuel cell drive system – including the methanol reformer – has been installed in the underbody of a Mercedes-Benz A-Class for the very first time. The vehicle therefore provides about as much space as a conventional A-Class. Since the NECAR 3 phase, in 1997, the engineers have succeeded in reducing the size of the system by half and fitting it within the sandwich floor. At the same time, they have managed to reduce the weight of the system, and therefore the weight of the car, by about 300 kg. While NECAR 3 required two fuel cell stacks to generate 50 kW of electric power, a single stack now delivers 75 kW in NECAR 5. And although the NECAR 5 experimental vehicle is heavier than a conventional car, it utilizes energy from its fuel over 25% more efficiently. The development engineers have also used more economical materials, to lower production cost.

Methanol ‘fuel’ could be sold through a network of filling stations similar to the ones we use today. The exhaust emissions from ‘methanolized’ hydrogen fuel cell vehicles are very much lower than from even the best internal combustion engines. The use of methanol-powered fuel-cell vehicles could reduce carbon-dioxide emissions by about a third and smog-causing emissions to nearly zero. Methanol can either be produced as a renewable energy source from biomass or from

natural gas, which is often burned off as a waste product of petroleum production and is still available in many regions around the world. To quote D-C board members, 'there have already been two oil crises; we are obligated to prevent a third one,' says Jürgen E. Schrempp, Chairman of the Board Of Management of DaimlerChrysler. 'The fuel-cell offers a realistic opportunity to supplement the 'petroleum monoculture' over the long term.' The company will invest about DM 2 billion (over $ 1 billion) to develop the new drive system from the first prototype to the point of mass production. In the past six years the company has already equipped and presented 16 passenger cars, vans and buses with fuel cell drives–more than the total of all its competitors worldwide. Professor Klaus-Dieter Vöhringer, member of the Board of Management with responsibility for research and technology, predicts the fuel cell will be introduced into vehicles in several stages 'In 2002, the company will deliver the first city buses with fuel cells, followed in 2004 by the first passenger cars.'

The electric-drive vehicle has thus moved out of the 'back-room' of automotive research into a 'design for production' phase and already hybrid drive systems (IC engine plus electric drive) have entered series production from major Japanese manufacturers. In the USA, General Motors has also made very substantial investments with the same objective. There is also very considerable interest throughout the world by smaller high-technology companies who can use their knowledge base to successfully enter the automotive market with innovative and specialist-application solutions. This last group will have much benefit from this book, which covers automotive structure, and system design for ultra-light vehicles that can extend the range of electric propulsion, as well as electric-drive technology and EV layouts for its main-stream educational readership.

NECAR5 fuel-cell driven car.