Section 4-1: Deployment

Table 4-1: Deployment: Depot Modifications – Challenges and Best Practice Solutions.

Challenges	Best Practice Solutions
Parking:	
• Determining how to configure FCB parking along with diesel parking and BEBs • There are no standards for depot adjustment as every depot is configured differently	• Today, some FCBs still require a cable connection for FC freeze protection. That is expected to be obsolete in the future, in moderate climates (western/central Europe) at least • A "safe" parking area may be required for buses that are awaiting checks for (suspected) H_2 leaks etc. Also, for purge of the H2 tanks
Bus Maintenance Facility:	
• Making a choice between a wide range of possibilities from basic retrofit to new customised facility, to contracting out maintenance to external offsite service provider	• Cost can often determine the choice of maintenance facility upgrade that is made. However, if FCBs are to be the bus of choice into the future, this cost should be amortised over a sufficiently long period • Costs varied widely in the CHIC project due to the differing contexts of the sites e.g., available financing, available footprint, pre-existing infrastructure, safety concerns etc. gives an overview of some key cost items
• There is a distinct range of tools required for working on FC Buses. At times these have been hard to source • Lack of standards or "How to" Guide for hydrogen-ready retrofits and new facilities • Permitting in this area is still developing and authorities still uncertain in this area causing delays	• Make sure you have tools for maintaining FCBs as part of the maintenance deal • The JIVE projects will produce a Guideline for FCB Maintenance workshops that can inform both a retrofit as well as a customised facility. In addition, there are safety specialists who have experience of FCB workshops and can assist with a safety audit that complies with local certification requirements. When in doubt stay on the side of caution • Retain backup diesel buses for some months after operations begin • As has been the case for bus depots previously: **Well-designed depots and well-trained staff = safe operations.**

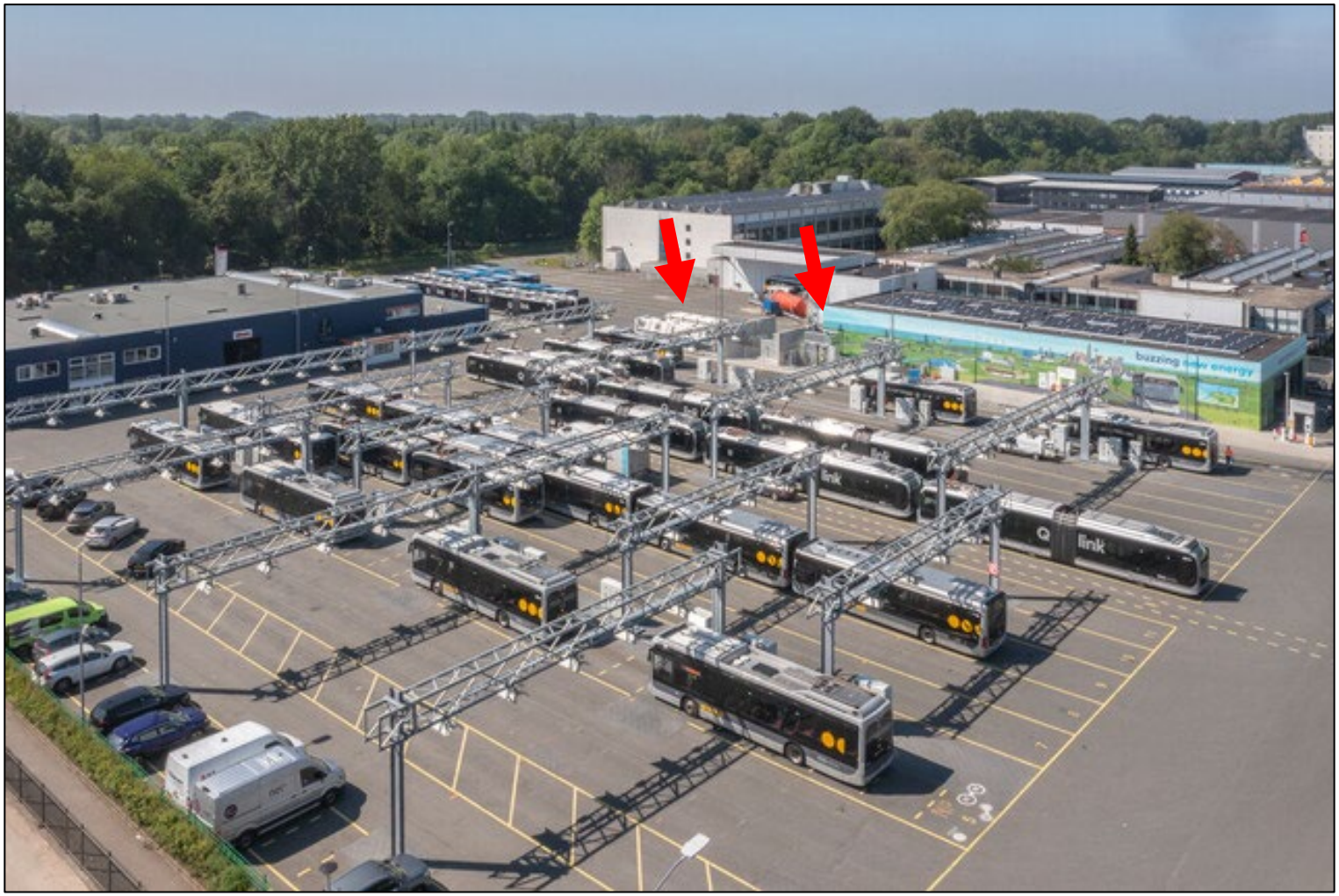

Figure 4-2: Sample layout of a functioning depot at Peizerweg Depot Groningen, The Netherlands / 1.
Photo shows the depot parking facilities for BEBs with 72 pantograph overnight chargers in front. The left arrow indicates the parking bays for two hydrogen supply trailers, the right arrow the location of the hydrogen compressors; see also next Figure. Photo by permission of OV-bureau Groningen Drenthe.

Figure 4-3: Sample layout of a functioning depot at Peizerweg Depot Groningen, The Netherlands / 2.
Photo shows on the left the two hydrogen compressors in front of the washing hall (with staff in high visibility vest) and towards the right the two hydrogen dispensers. Figure 4-7 shows one of them in more detail. Photo by permission of OV-bureau Groningen Drenthe.

Table 4-2: Deployment: Cost ranges of some key element when fitting a workshop for servicing FCBs.
From "Analysis of investments in workshops for fuel cell buses and hydrogen refuelling stations", CHIC Project D3.11, 2015, see Resources in Table 4-13.

Part	Investment cost [€]
1. H_2 specific incremental investment cost for workshop equipment per bay:	
A) Retrofitting under ideal conditions (some existing components like existing ventilation for example)	30,000 to 60,000
B) H_2 specific investment cost for the workshop under normal conditions (applying H_2 sensors, ATEX lights and ventilation, emergency venting etc.) for 12m standard bus bay	75,000 to 100,000
C) H_2 specific investment cost for the workshop under normal conditions (applying H_2 sensors, ATEX lights and ventilation, emergency venting etc.) for 18m articulated bus bay	190,000 to 230,000
2. Changes to the workshop structure	
Extra windows or fire protective doors	5,000 to 15,000
3. Rooftop working:	
A) Simple mobile working platform for rooftop working	5,000 to 15,000
B) Technically sophisticated solution for rooftop working covering whole length of the bus and moving hydraulically around the bus	90,000 to 150,000
4. Power outlet for overnight power supply at parking space	1,000 to 1,500 per power outlet

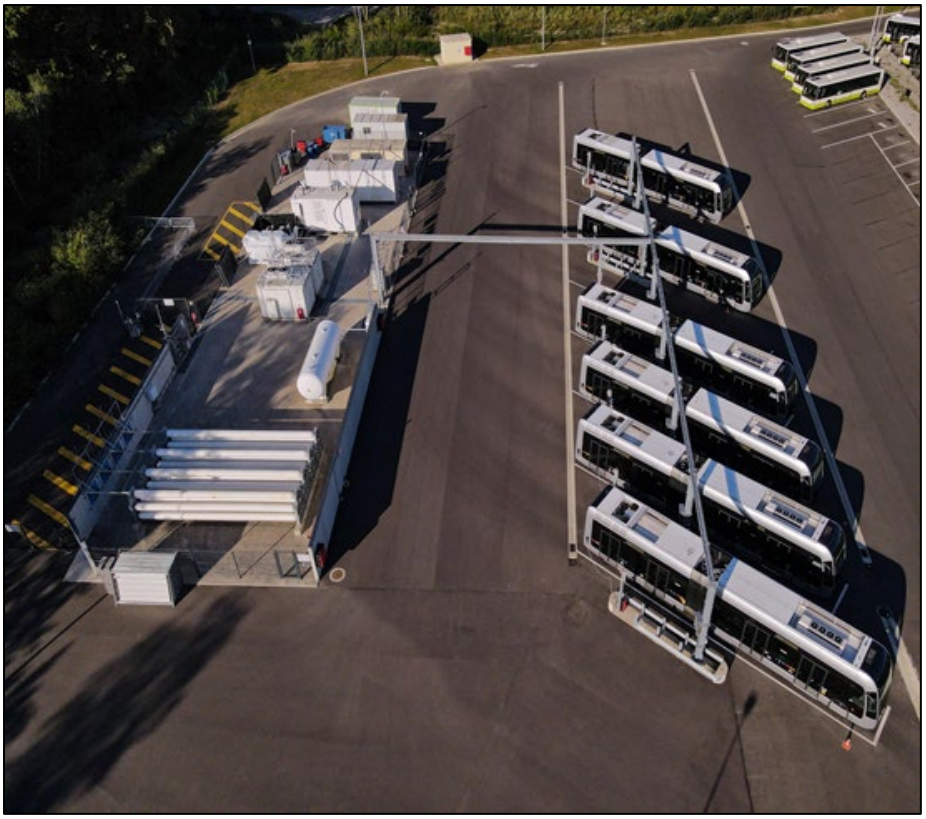

Figure 4-4: HRS with on-site hydrogen generation in Pau, France. H_2 production and storage facility is shown at the left of photo. Buses are sequentially refuelled overnight at their parking bays. Photo by permission of Syndicat mixte Pau Béarn Pyrénées Mobilités.