

WIND TUNNEL REQUIREMENTS:

AN AUTOMOTIVE MANUFACTURER'S PERSPECTIVE

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OVERVIEW

AERODYNAMIC DEVELOPMENT PROCESS

Summary of overall process and how wind tunnels are used

WIND TUNNEL REQUIREMENTS

Key characteristics of wind tunnels used for automotive development and their drivers

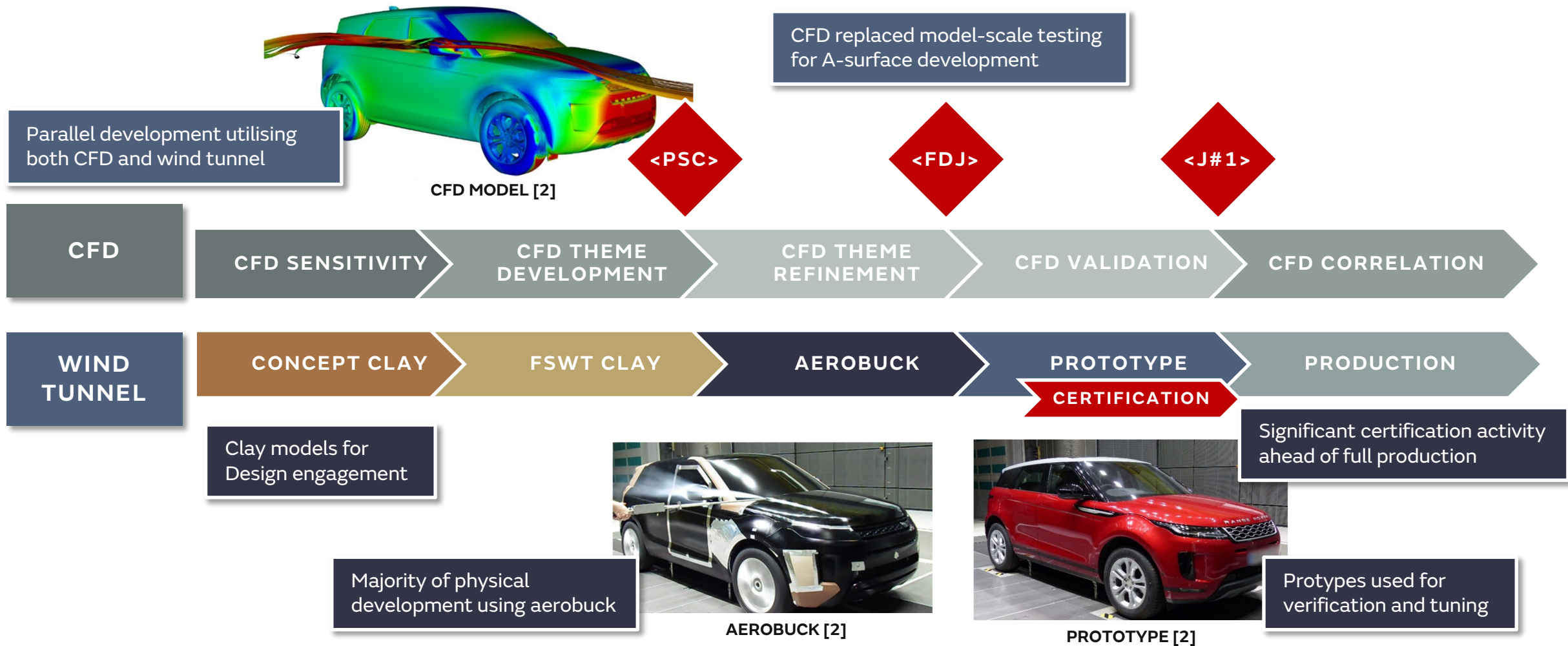
UK CHALLENGE

Current gap between UK wind tunnel capability and the needs of an automotive manufacturer

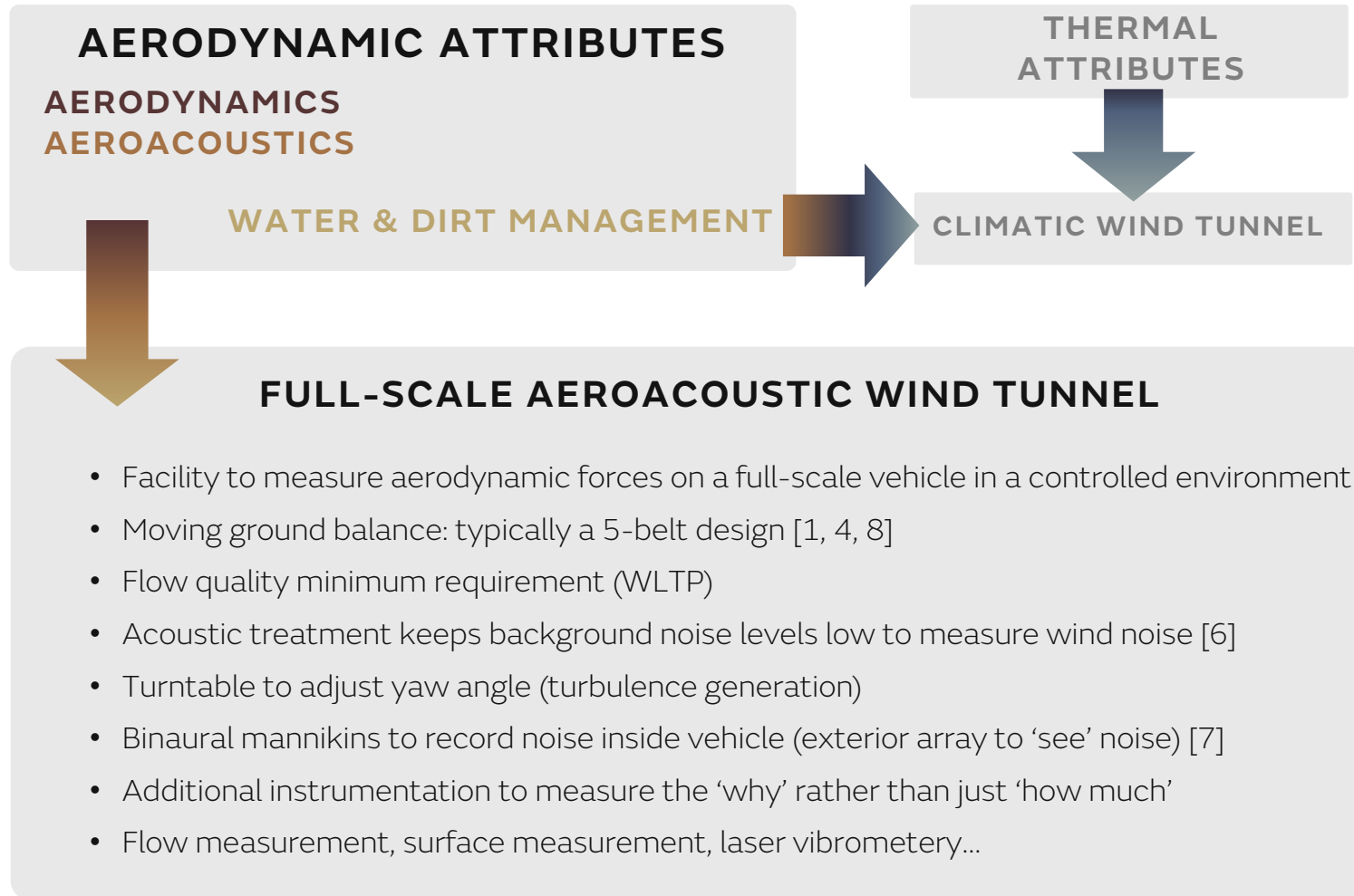
THE FUTURE

Changes to demand in the future and opportunities to close the UK automotive wind tunnel gap

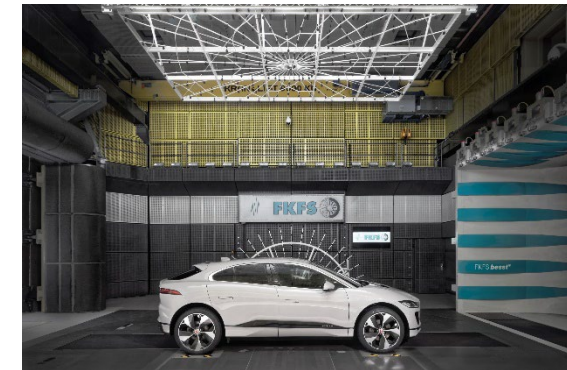
AERODYNAMIC DEVELOPMENT PROCESS [5]



WIND TUNNEL REQUIREMENTS



**MOVING GROUND AND TURNTABLE;
TRAVERSE; TURBULENCE GENERATION [1]**



**BEAMFORMING ARRAYS; ACOUSTIC
TREATMENT [7]**

UK CHALLENGE

**NO UK-BASED AERODYNAMIC FACILITIES TO MEET AN
AUTOMOTIVE MANUFACTURER'S REQUIREMENTS**

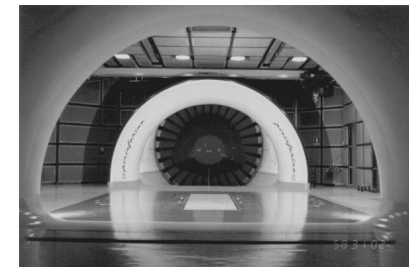
- No certification can take place in the UK: reliant on wind tunnels overseas
- Customer wind tunnels (examples presented), or tunnels from sister companies
- Capacity limitations drive the amount of development and R&D time after certification
- Limits to collaboration with other departments (design, engineering)
- Shipping impact - prototype utilisation efficiency, paperwork
- Increased vulnerability to external factors



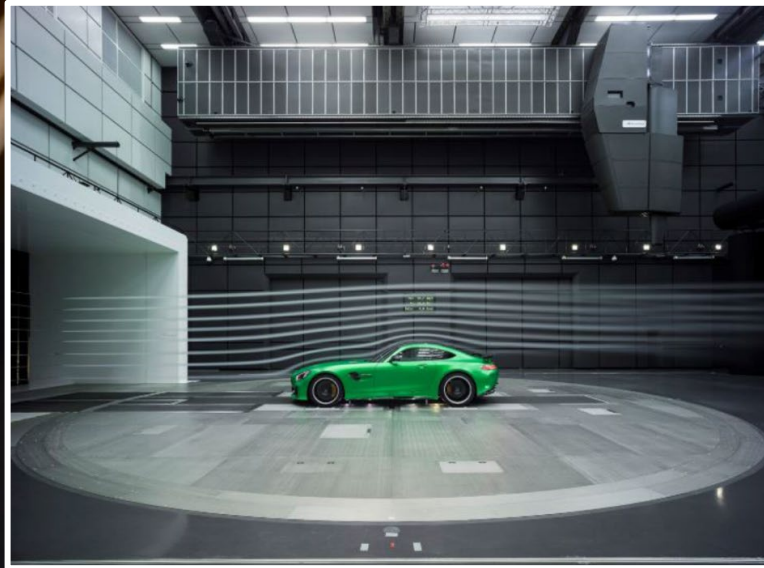
S2A [8]



FKFS [1]



PININFARINA [4]



**MODERN, FULL-SCALE AUTOMOTIVE AEROACOUSTIC
WIND TUNNEL [3]**

THE FUTURE

DEMAND

- Increased demand driven by certification in increased number of markets
- More stringent targets – efficiency, refinement – drives increase in both CFD and wind tunnel usage
- Data output – increased richness of data to support AI supported development

CURRENTLY A FACILITY GAP WITHIN THE UK

- Appetite for wind tunnels specified for needs of automotive manufacturer within other industry sectors?
- Other manufacturers?
- Academic interest in such a facility, potentially part of NWTf?
- FKFS as example: commercial facility part of university, located in automotive industrial region, PhD and internship programmes
- Wider user base, wind engineering, sports?

REFERENCES

1. Blumrich, R., Widdecke, N., Wiedemann, J., Michelbach, A. et al., "**New FKFS Technology at the Full-Scale Aeroacoustic Wind Tunnel of University of Stuttgart**," SAE Int. J. Passeng. Cars - Mech. Syst. 8(1):294-305, 2015, doi:10.4271/2015-01-1557.
2. de Boer, M., Gaylard, A., and Parmar, B., "**The Aerodynamic Development of the New Range Rover Evoque**," SAE Int. J. Adv. & Curr. Prac. in Mobility 5(1):97-105, 2023, <https://doi-org.imeche.idm.oclc.org/10.4271/2022-01-0890>.
3. Buckisch, R., Schwartekopp, B., and Pfisterer, J., "**Daimler Aeroacoustic Wind Tunnel: 5 Years of Operational Experience and Recent Improvements**," SAE Technical Paper 2018-01-5038, 2018, doi:10.4271/2018-01-5038.
4. Cogotti, A. "**Upgrade of the Pininfarina Wind Tunnel – The New “13-Fan” Drive System**," SAE Technical Paper 2006-01-0569, 2006
5. Gaylard, A. P., "**The Appropriate Use of CFD in the Automotive Design Process**," SAE Technical Paper 2009-01-1162, 2009
6. Oettle N, Sims-Williams D. "**Automotive aeroacoustics: An overview**," Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering. 2017;231(9):1177-1189. doi:10.1177/0954407017695147
7. Smith, O., Oettle, N., "**Visualisation of Roof Bar Noise Sources through the Use of Acoustic Beamforming and Computational Aeroacoustics**," SAE Technical Paper 2023-01-0840
8. Waudby-Smith, P., Bender, T., Vigneron, R., "**The GIE S2A Full-Scale Aero-acoustic Wind Tunnel**," SAE Technical Paper 2004-01-0808, 2004

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