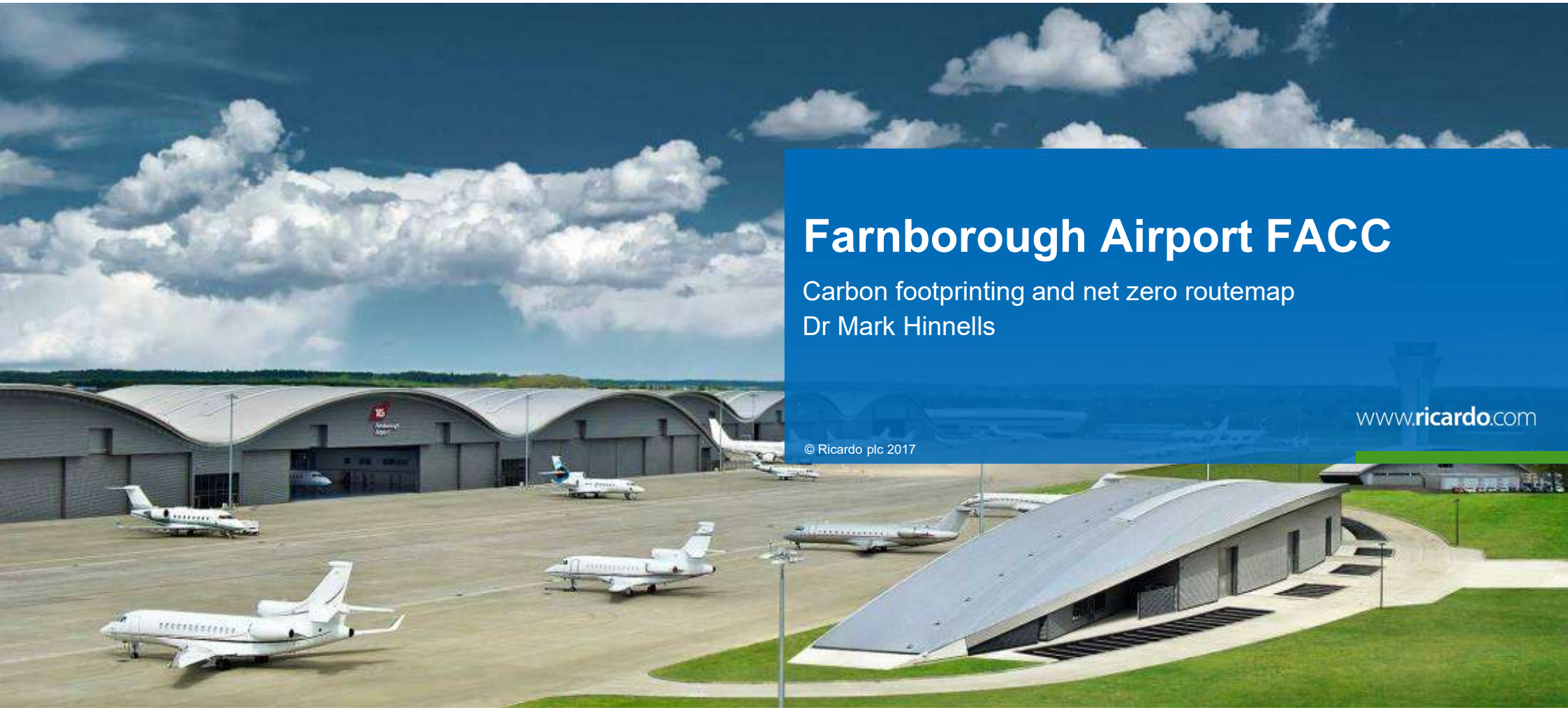


Farnborough Airport FACC

Carbon footprinting and net zero routemap

Dr Mark Hinnells

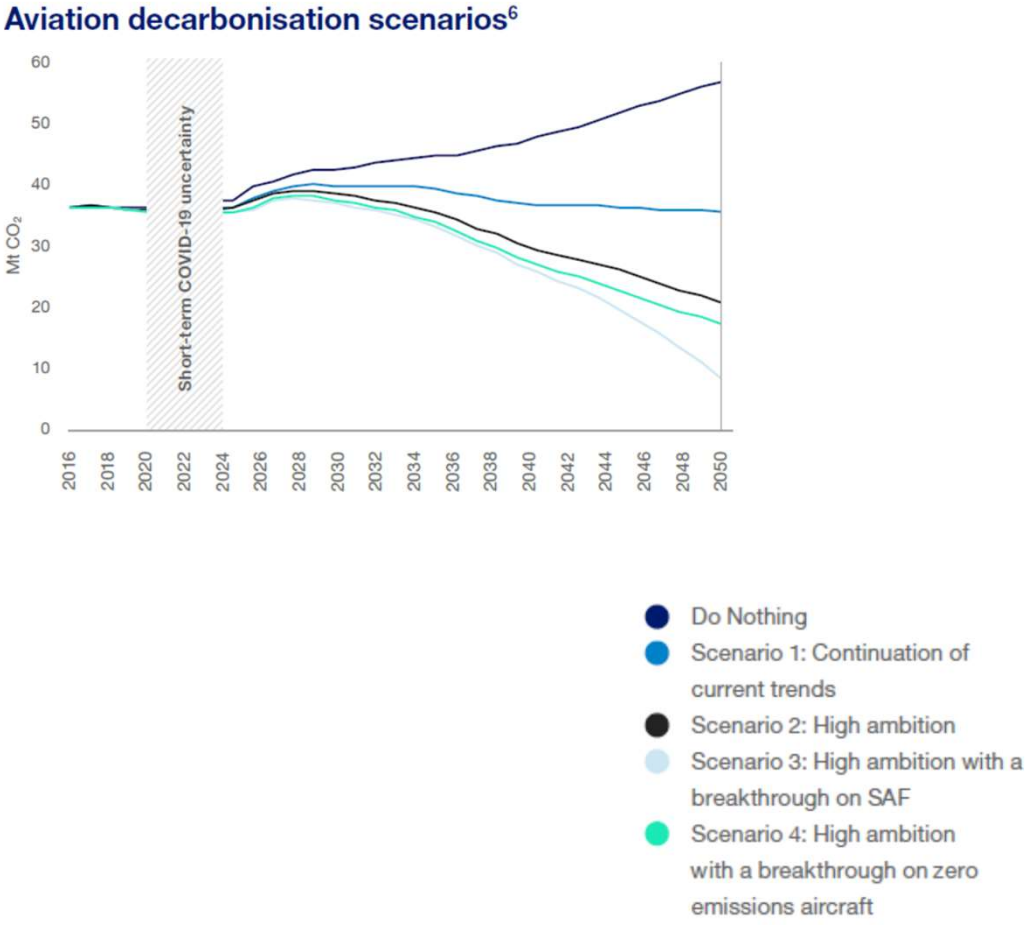
www.ricardo.com

Introduction to Ricardo

- Ricardo started in Shoreham in 1915 supporting work on engine efficiency in WWI
- Grown into a international consultancy supporting vehicle development, trains, stationary power, aerospace and environment (climate, air quality and water)
- Working towards a vision of a world where we can all live sustainable lives
- Work for both industry and government (EU, national and local)
- My role is within the Sustainable Infrastructure team, working on airport assets, water industry assets, the rail network
- Our team undertakes footprinting and solutions like renewable energy and sustainable fuels

Introduction

- UK Government has committed to include aviation within UK sixth carbon budget (78% cut by 2033-37) and net zero 2050
- Jet Zero consultation last summer, explored how to get aviation to net zero carbon emissions with an expectation of a 60% increase in passenger numbers
- Included objective of net zero for airports by 2040, zero emission UK flights by 2040 and net zero international aviation by 2050
- Aviation is an international market and policy intervention is both international and national
- Explored aircraft efficiency, Sustainable Aviation Fuels, and new technologies in electric and hydrogen aircraft, and carbon offsets and removals
- Likely to be significant need for offsets for **Airlines** even in 2050 but the offsets market is largely unregulated and future costs are uncertain
- **Airport** decarbonisation focus is on ground based activities, decarbonising own operations, and supporting aviation industry clients with appropriate infrastructure

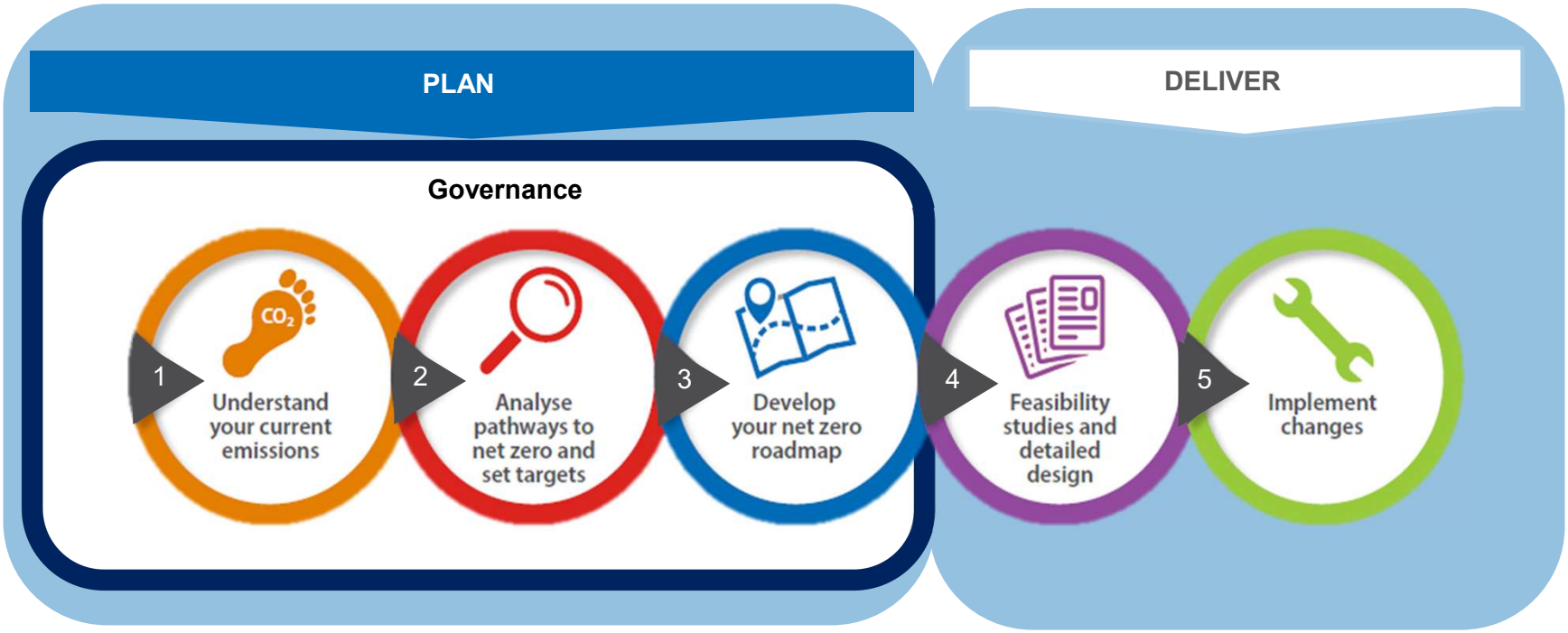


Carbon emissions reporting

- All our organisational carbon footprints are calculated in accordance with two internationally recognised and interlinked standards:
  - The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard.
  - ISO 14064-1, Specification with Guidance at the Organisation Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals
- Large Undertakings have an ESOS (Energy Savings Opportunities Scheme) reporting obligation- next deadline end of 2022 for organisations over 250 people
- Some large organisations (especially pension owned assets) are requiring reporting under TCFD (Task Force on Carbon Related Financial Disclosure)
- Airports have their own framework – Airport Carbon Accreditation

Airport Carbon Accreditation

Approach


PLAN
DELIVER
Governance
1
Understand your current emissions
2
Analyse pathways to net zero and set targets
3
Develop your net zero roadmap
4
Feasibility studies and detailed design
5
Implement changes

Carbon footprint calculation

Scope 1 Emissions Sources

- Fuels used in heating and generation
- Airport owned/operated ground support equipment (including operational vehicles)
- Fuels burnt during fire training
- Refrigerant gases lost to atmosphere
- Business travel (hire car fuel, pool car fuel/mileage)
- Renewable electricity generation

Scope 2 Emissions Sources

- Purchased electricity
- Purchased heat/steam/cooling

ACA Level 3 Scope 3 Emissions Sources

- Aircraft landing take-off cycle (LTO) & APU usage
- Aircraft engine testing
- Third party ground support equipment (including operational vehicles)
- Passenger surface access emissions
- Staff commute emissions (Airport staff only, or including third party staff)
- Tenant electricity (if submetered)
- Business travel (public transport, flights, grey fleet)

ACA Level 4 Scope 3 Emissions Sources

- Aircraft climb, cruise and descent (CCD)
- De-icer (surfaces and aircraft)
- Water supply and treatment
- Waste disposal
- Refrigerant gases lost to atmosphere (Scope 1 and 3)
- Third party non-road construction vehicles and plant emissions (Only applicable if construction has occurred on site in the footprint year).

Carbon Emissions by Source and Activity 2020 - 1

Farnborough Airport's emissions can be broken down by activity as seen in this table.

Aircraft movements include LTO and APU emissions

The main activities that contribute to the footprint are aircraft movements and utilities

Utilities include heating fuels and refrigerant usage in the terminal as well as electricity consumption and glycol based de-icer

Business travel and fire training contribute a small overall percentage to the carbon footprint

Emissions Source	Scope 1 (tCO_2e)	Scope 2 (tCO_2e)	Scope 3 (tCO_2e)	Outside of Scope (tCO_2e)	Total (tCO_2e)	% of Total Emissions
Aircraft movements	0	0	4,277	0	4,277	63%
Utilities	962	0	322	0	1,284	19%
Waste	0	0	448	0	448	7%
GSE	223	0	24	4	251	4%
Passenger surface access	0	0	237	0	237	4%
Staff commute	0	0	236	0	236	3%
Fire Training	11	0	0	0	11	0%
Business travel	1	0	6	0	7	0%
Total	**1,196**	**0**	**5,549**	**4**	**6,750**	**100%**

Accounts for the direct carbon dioxide (CO_2) impact of using biofuels

Net zero routemap

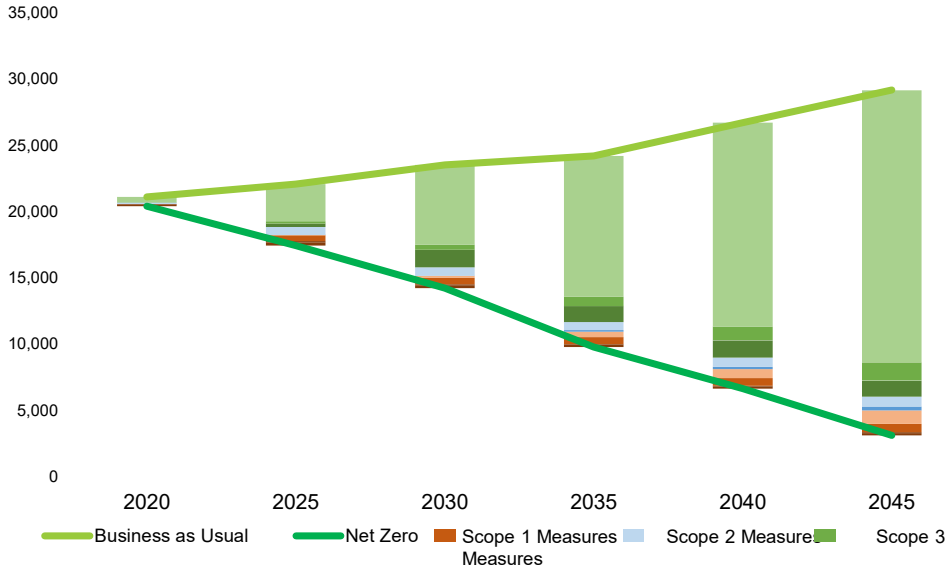
Business as usual emissions trajectory

Once a baseline has been established, we calculate a business as usual (BAU) emissions trajectory for Farnborough Airport out to 2050 based on:

- The current energy mix used at the airport
- Projected growth of the airport
- Expected changes in relevant UK Government policies
- Current investment plans at the airport.

Mitigation options

1. Heating & buildings
2. Power (including renewables)
3. Energy efficiency
4. Transport
5. Aviation



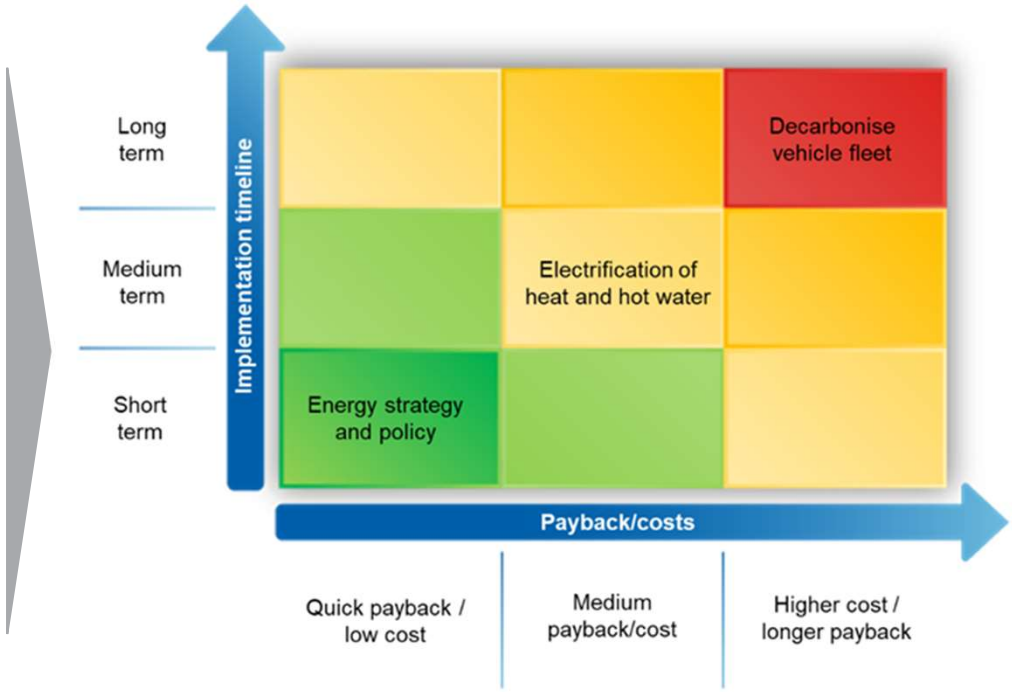
Net zero routemap

Mitigation options will be developed across each of the different categories. These will be a mix of options that can be implemented in the short, medium term and long term across each category.

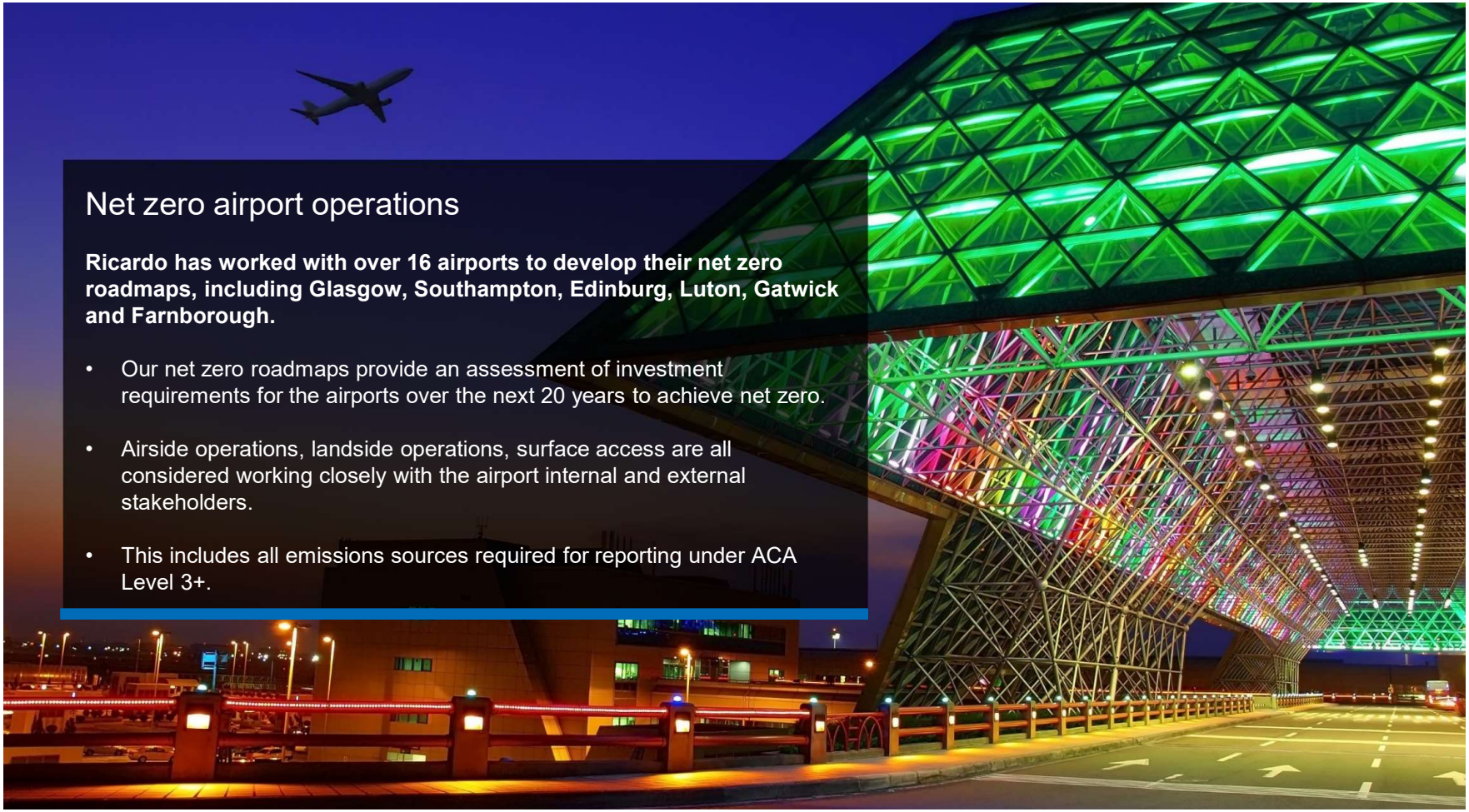
For each measure, the following will be calculated:

- Carbon/energy savings
- Implementation timeline
- CAPEX and OPEX

Measures would need to be developed into project briefs to take forward for further feasibility analysis.



Any questions?



Net zero airport operations

Ricardo has worked with over 16 airports to develop their net zero roadmaps, including Glasgow, Southampton, Edinburg, Luton, Gatwick and Farnborough.

- Our net zero roadmaps provide an assessment of investment requirements for the airports over the next 20 years to achieve net zero.
- Airside operations, landside operations, surface access are all considered working closely with the airport internal and external stakeholders.
- This includes all emissions sources required for reporting under ACA Level 3+.

Energy management, utility supply and low carbon operations

- Terminal energy strategy – providing a clear and coherent set of actions to cut energy costs, starting with the simplest and best investments.
- Combined heat and power (CHP) assessment – options to reduce electricity and heat costs and carbon emissions.
- Renewable energy options analysis – reducing dependence on fossil fuels and hedging against future energy price rises.
- Grid infrastructure – assessing the impact of EV charging on infrastructure and costs.
- Airport Carbon Accreditation (ACA) and carbon footprint auditing.
- Regulatory assistance (e.g. ESOS, CRC) to maximise opportunities from carbon reductions and support compliance.

Sustainable transport and fleet management

- Vehicle fleet analysis and alternative fuel options appraisal to help fleet operators to reduce their emissions and improve cost efficiencies.
- Engagement and behaviour change strategies for drivers and operators, to help reduce fuel consumption and accident rates, whilst maximising opportunities for cost savings.
- Alternative fuel vehicle trial management and performance assessment.
- Airport fleet operator engagement to share information and encourage adoption of low emission vehicles amongst vehicle operators not directly under the control of airports.
- Zero emissions zone modelling, planning and development, to support a long-term transition towards low emissions ground-based fleets.
- Alternative aircraft taxi mechanisms and associated modelling, to reduce the environmental impact of aircraft taxiing.

Sustainable Aviation Fuels

Ricardo has been involved in a number of significant sustainable aviation fuels (SAF) projects:

Impact assessment of SAF for European Union ReFuel EU

- This study reviewed policy options that can be applied to support the large scale production and use of Sustainable Aviation Fuel of high sustainability potential in the EU at competitive prices.
- The work included research, stakeholder interviews and surveys and a formal open public consultation. A number of policy options were identified, tested with stakeholders and compared against each other and the baseline to recommend a preferred solution.
- ReFuel EU is due to be published as part of the EU Fit for 55 on July 14th 2021.

Aviation Advanced Biofuels Demonstration Competition

- Ricardo and a partner conducted the feasibility study for the UK Department for Transport to explore the feasibility and benefits of a new innovation competition targeting renewable/sustainable aviation fuels. The ambition is to pave the way for first-of-a-kind commercial scale plants in the UK.

Future Fuels for Flight and Freight Competition (F4C)

- Ricardo is managing this project for the Department for Transport (DfT) to promote the development of an advanced low carbon fuels industry within the UK. The F4C will provide up to £2 million of Project Development Funding and up to £20 million in capital grant funding.

Multi-Stack Hydrogen Fuel Cell System for 9 Seater Passenger Aircraft

Hydrogen Mobility

- Ricardo's team will:
  - Specify, design, procure, build, test, develop and deliver Hydrogen Fuel Cell Systems, including Balance of Plant, for integration into a light aircraft.
  - Overcome extreme fuel cell system performance, weight and packaging challenges.
- The benefits of Ricardo's work:
  - Digital tools enable rapid identification, down selection and optimisation of a multi-fuel cell stack system architecture.
  - Full system engineering capability across hardware and software.
  - One-stop-shop hydrogen fuel cell system development capability from requirements, through design, build and test.
  - Application of light-weighting capabilities and design innovation to achieve best in class system power density.
- Technical solution
  - 250-300kW fuel cell system per wing, specific power > 1.5 kW/kg.
  - Compressed gas tank 700 bars.
  - Optimised powertrain HW and SW.