

# RenewableUK Wind & Aviation 2019 Think Piece & Action Plan

Draft 04/11/19

# AVIATION & WIND - THINK PIECE AND ACTION PLAN

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## EXECUTIVE SUMMARY

While there has been some progress in addressing aviation matters over the last decade, aviation objections still present significant obstacles to the development of onshore and offshore windfarms. As a contribution to making the necessary progress, RenewableUK held a Wind and Aviation event in Birmingham in 2019, aiming to identify what would best help shape the wind industry's strategy, priorities and actions. The event was structured around four workshops covering the following key topics:

- radar and surveillance
- helicopter and drone operations in support of the wind industry
- lighting and marking of turbines.

Over 120 participants from the wind and aviation industries, their suppliers and service providers, as well as from UK Government and regulators, took part.

The outcomes were recorded and collated in an event report. The present report complements the event report by:

- further analysing the event findings, taking account of the wider context
- developing a proposed action plan for RenewableUK to take forward.

For the surveillance challenge, RenewableUK and the wind sector need to lead proactively, driving changes to policy and culture, providing the main inputs, and ensuring stakeholder engagement.

In relation to helicopters and drones, and lighting and marking, the wind industry is one of many stakeholders. In some aspects, it will be for others such as the aviation / maritime regulators and standards bodies, to take the formal lead. Nevertheless, RenewableUK and the wind sector need to ensure that the wind industry remains engaged and is able to contribute.

It is recommended that Renewable UK, working with other stakeholders such as OWIC<sup>1</sup> and AIFCL<sup>2</sup>, should:

- review, refine and if appropriate adopt the Action Plan presented in this report, integrating it into the RenewableUK work programme
- keep stakeholders informed and engaged, for example through regular Wind and Aviation events.

## 1. INTRODUCTION

### 1.1. Background

Despite some progress in addressing aviation matters over the last decade, aviation objections still presented significant obstacles to the development of onshore and offshore windfarms. At the Wind Europe/RenewableUK Aviation event in Hamburg in September 2018<sup>3</sup>, there was consensus that a renewed approach to resolving these challenges was required. The event concluded that there was both an opportunity and an enthusiasm to move forward. This would require a concerted effort and an agreed set of initiatives to avoid the situation whereby the same issues were being discussed with little progress 12 months on.

As a key element in making the necessary progress, RenewableUK held a Wind and Aviation event at the NEC, Birmingham on 30 April 2019, aiming to identify what would best help shape the wind industry's strategy, priorities and actions necessary to re-energise engagement on aviation issues.

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<sup>5</sup> <https://www.gov.uk/government/publications/wind-turbines-and-aviation-radar-mitigation-issues-memorandum-of-understanding-2011-update>

The Birmingham event was structured around four workshops covering each of the key topics that had previously been raised at Hamburg and elsewhere, as follows:

- radar and surveillance
- helicopter and drone operations in support of the wind industry
- lighting and marking of turbines

Over 120 participants, from the wind and aviation industries, their as well as from government, regulators, suppliers and service providers, took part.

The outcomes were recorded and a post-event analysis conducted, identifying the following key findings:

- a. Radar and Surveillance remains the most significant factor affecting wind turbine deployment.
- b. To take a proactive approach, a revitalised initiative is required which is led by government.
- c. Without this government lead and ambition, it will not be possible to change the approach which, whilst appropriate in the early days of wind energy, is no longer relevant when the government seeks a net-zero ambition.
- d. There is a need to ensure that future surveillance policies, strategies and technologies recognise that wind turbines are now part of the normal low airspace operating environment.
- e. Heli-ops are a key element in supporting wind turbine operations and there are some areas where more collaborative action could be beneficial.
- f. There needs to be greater clarity about aviation's requirements for lighting and marking in order to realise the benefits of greater consistency. This should also take into account how demand-activated, or proximity-activated, lighting can reduce environmental impact and cost whilst still ensuring safety.
- g. It will be important for the wind sector to be actively engaged in the UAS regulatory, airspace and UTM development so that the potential benefits for wind can be realised.
- h. The wind industry needs to be clear about where its responsibilities lie as a customer of helicopter and drone services, rather than as a specialist operator.

A detailed report of the Birmingham event [Ref 1] has been provided to RenewableUK.

## **1.2. Objectives and Scope**

The event report [1] is primarily a factual record and collation of the discussions at Birmingham. This think-piece complements it by:

- further analysing the event findings, taking account of the wider context
- developing a proposed action plan for RenewableUK to take forward.

The aviation/ wind topics covered at the Birmingham event, and hence by the event report and this think-piece, are the main areas in which aviation policy, regulatory and technological considerations, such as provision and use of airspace and CNS infrastructure, or aircraft operators' requirements for lighting and marking of turbines, may either support or constrain the development of the wind industry. These are areas in which the needs of both the aviation and wind sectors, and the wider needs of society (for example the need for decarbonised, safe, secure, and affordable energy) need to be recognised and provided for, reconciling any differences in a just and transparent way.

The report is not concerned with the details of aviation services and activities contracted by the wind industry in support of wind farm construction, operation and maintenance, such as the use of aircraft for surveys or technician transfer.

## **1.3. Report structure**

Section 2 presents a summary and further analysis of the Birmingham event findings.

Section 3 identifies wider, political context factors that may set constraints and offer opportunities for wind industry actions.

Section 4 outlines proposed action plans for RenewableUK to take forward, working with its industry partners.

The Appendices present more detail of the action plans, including outcome milestones and timescales where possible, and identifying what enablers would need to be in place.

## **2. ANALYSIS OF EVENT FINDINGS**

Reflecting on the feedback from the Wind and Aviation event, we found that the suggestions for progress could be grouped into the following strands:

- i) Political, structural and organisational
- ii) Technical and operational
- iii) Stakeholder engagement

A summary and further analysis of the findings under each of these strands are presented in Sections 2.1 to 2.3 respectively

### **2.1. Strand (i) - Political, structural and organisational**

In reviewing the period from 2005 to the 2019 NEC Wind and Aviation event, political, structural and organisational factors have been a major challenge. The obstacles and lack of enablers to tangible and enduring progress include: inconsistent direction and lack of coordinated and consistent leadership by the UK Government; a reliance on a 'the market will resolve the problem' attitude; a reliance on the wind industry to resolve one element of an evolving general surveillance complex clutter challenge for land, sea and air; and a lack of a specific future UK and EU 'surface-to-space' surveillance strategy. These over-arching weaknesses in pan-sector leadership, processes and strategy are exacerbated by: internal wind sector commercial competitiveness driving case-by-case mitigation arrangements; a lack of aviation/wind industry cooperation; the wind sector not acknowledging that its wind turbine and windfarm designs must generate less interference; and lack of acceptance by the aviation and surveillance stakeholders that wind turbines, and other emerging low level airspace users, are now, and will increasingly become, part of the 'new normal' landscape.

### **2.2. Strand (ii) - Technical and operational**

With an accelerating evolution of detection approaches, data processing and analysis power and new technical pan-sector, and smarter operational approaches, the challenges of providing safe and secure airspace in a growing complex clutter environment appear resolvable. However, this will require a robust, detailed and scientific-based understanding of the problem today, and a holistic and facts-based projection of the airspace challenges to 2050. This will include the need for appropriate interference baselining, surveillance system requirement setting and future performance boundary definition and setting, accurate understanding of how wind turbine and windfarm design and construction can reduce the interference challenge, and how other emerging airspace users will add to the challenges or solutions. Any, likely hybrid, solution will only come to fruition via a national strategic surveillance strategy that coordinates the coherent longer-term design considerations for wind turbines and windfarms, surveillance systems, and other airspace users, that will allow pragmatic operational airspace risk management and enduring public and private investment. However, these technical and operational issues can only deal with the important blocking issues if pan-government strategy, policy and leadership ensure cross-sector willingness and cooperation. The need for resolution must be clearly driven by the end user customer demand for safe and secure airspace governance, allowing the necessary developments in all stakeholder sectors to develop the pan-sector permissive environment required.

### **2.3. Strand (iii) - Stakeholder engagement**

Similarly, effective stakeholder engagement can follow relatively straightforwardly if government provides the right leadership, policy drivers and incentives.

## **3. THE WIDER CONTEXT**

This Section identifies factors in the wider context that may set constraints and offer opportunities for wind industry actions.

Given current political instability in the UK, the wind industry's arguments need to be even more firmly anchored in the science – the need to decarbonise – and commitments made by the UK. Specific commitment 'anchors' include the 'Net Zero' legislation: *Climate Change Act 2008 (2050 Target Amendment) Order 2019* and the relevant sector deals. However, stakeholder sector deals need to be coordinated and complementary to highlight the an-sector challenge to be addressed and resolved by multiple sector cooperation. The wind sector deal (offshore and onshore) needs to recognise it has a part to play in reducing the interference challenge from current and future wind turbines and wind farms. Aviation sector surveillance product/service providers and ANSPs need to acknowledge that low-level clutter is a general background display issue that they have to deal with. Interference from wind turbines, drones, small personal aircraft, space launches, more extremes of weather etc, must be addressed as the 'new normal' clutter management challenge from 'surface-to-space'. Manned and unmanned air system operator stakeholders need to understand the low-level airspace surveillance and ATM challenges and assist in provision of safe low airspace flying conditions. All airspace user and governance stakeholders must proactively cooperate, coordinate and collaborate to find the compromises required.

While the need to decarbonise energy has been accepted, at least in principle and at policy level, by all major parties, government willingness to take the necessary steps to address wider energy policy issues, as well as the specific low level airspace interference challenges associated with wind turbines, has been erratic. In some cases, such as reducing financial and planning policy support for renewables, whilst supporting fossil fuel developments and airport expansion, government actions have appeared contradictory. It is hard to forecast how any new UK government will approach decarbonisation, especially what their attitude will be to new onshore wind development given recent government focus on offshore wind development and increasing weight being given to objections to onshore wind proposals.

Further obstacles to resolving the issues include:

- a. Verifying the accuracy and reliability of the 'proposed wind farm interference' prediction tools and subsequent real world interference from operational wind farms;
- b. The 'hearsay' approach to interference objections and general lack of tangible hard technical and operational evidence regarding what interference is actually generated and what actual impact this has on ATM safety, etc. There is no scientific tangible 'ground truth' evidence as to the exact wind turbine detrimental impact on the performance of UK surveillance systems and the consequential impact on 'clutter' displayed to ATM and AD operators and how that impacts on their service provision performance.
- c. The increased carbon generated by aircraft having to be diverted around wind farms has not been evaluated.
- d. The current mitigation acceptance or not on a case by case basis by each ANSP does not allow the development of regional or national approaches or strategies.
- e. Non-expert planning officers making 'best endeavours' decisions, many inconsistent, on windfarm planning proposals.
- f. There is currently no agreed assessment of the development potential for wind turbines over the next 20-30 years in terms of design, size and number, on which the aviation industry can base its plans.
- g. There is a need to create an understanding amongst all parties that wind turbines, as part of the normal background environment, are an input to the range of significant aviation programmes that are currently being pursued at both national and international level. These include, in particular, restructuring airspace, development of surveillance strategies based on a layered approach encompassing both cooperative and non-cooperative surveillance, and the introduction of new technologies such as MSPSR.

## 4. DEVELOPING AN ACTION PLAN

We have developed the Action Plan to start with what the wind industry itself (with RenewableUK taking a lead in the first instance), can do.

Sections 4.1 to 4.3 respectively outline the key features of the proposed Plan, broken down into three topics as follows (reflecting those used at the Birmingham event):

- resolution of surveillance interference issues - Section 4.1
- collaboration between airspace users (this rolls together the helicopter and drones topics from Birmingham, as many of the issues were found to be similar) – Section 4.2
- lighting and marking – Section 4.3.

Further details of the proposed Action Plan, including outcome milestones and timescales where possible, and identification of what enablers need to be in place, are presented in Appendix A. A tentative timeline for the surveillance interference topic, the most complex of the three, is presented in Appendix B.

### 4.1. Surveillance Interference Resolution

In broad terms, the suggested action themes under each of the three identified strands are as follows:

i) **Political structural and organisational:**

- The UK has historically shown itself to be a leader in investigating and generating options to address many of the wind turbine and aviation issues. It is therefore, in a good position to demonstrate and lead initiative in taking a holistic approach which links the environmental issues with the sustainability of aviation.
- engagement at the highest levels of government, to make the case for their leadership, and acceptance of the need for government leadership by Aug 2020;
- review, refresh and revitalisation of the 2011 Memorandum of Understanding<sup>5</sup>, or an equivalent document, to bring together and get buy-in from the principal stakeholders, signed by all by Aug 2020. As well as being updated and reviewed, it perhaps needs additional signatories from the radar/surveillance sector and aircraft operators;
- facilitating a Ministerial-led forum for government, aviation (ANSP, surveillance providers, and air system operators), maritime and wind sector leaders that can agree and commit to, and contribute resources and funds to, a coherent action plan to provide robust interim mitigations to this challenge by 2025, and enduring solutions by 2030. First Minister-led forum to sit by Aug 2020.

ii) **Technical and operational:**

- review windfarm proposal assessment, analysis, scrutiny and approvals/objection processes, methodologies and tools used in the UK and abroad by Dec 2020;
- review and benchmarking of UK and overseas airspace infrastructure, airspace control regulations, surveillance system user, and ANSP operational challenges by Dec 2020;
- review, measurement and benchmarking of UK and overseas surveillance system technical interference challenges from wind turbines in RLOS by Dec 2020;
- review, measurement and benchmarking of wind turbine and windfarm design, construction and EMI measurement and metrics by Dec 2020;
- develop R&D and modern approaches to windfarm proposal assessment, analysis, scrutiny, certification and approvals/objection processes, methodologies and tools for use in the UK, and available for use abroad, by Dec 2021;
- develop proposals for UK and overseas airspace infrastructure, airspace control regulations, surveillance system user, and ANSP operational changes to cope with future airspace challenges by Dec 2022;
- develop R&D and technical design, construction and layout solutions for low interference wind turbines and wind farms by Dec 2022;

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<sup>5</sup> <https://www.gov.uk/government/publications/wind-turbines-and-aviation-radar-mitigation-issues-memorandum-of-understanding-2011-update>

- developing R&D and interim technical solutions for more complex target and complex clutter interference resilience of current radars and surveillance systems by Dec 2023;
- developing R&D and enduring future technical solutions for a wide spectrum of complex target and complex clutter interference resilience of updated and new radars and surveillance systems by Dec 2024;
- Low EMI wind turbines and high EMC complex clutter resilient and tolerant surveillance systems, from ‘surface-to-space’, deployed by 2025.

iii) **Stakeholder engagement:**

- engaging with stakeholders (airports, NATS and smaller ANSPs, CAA, MOD) and surveillance product/service providers. Airports and smaller ANSPs were under-represented at the NEC event and ways need to be found to engage them more effectively.
- the stakeholder group should be expanded to include representatives of current and emerging manned and unmanned aircraft operators who are the ultimate ‘end users’ of the lower airspace.
- Wind turbine interference in the lower airspace is not a unique UK issue, it is a global issue. UK should engage and coordinate globally, especially with Europe and the USA, to learn lessons from similar activity to define, quantify and resolve these challenges globally.

## 4.2. Low Airspace User Collaboration

Helicopters are a key element in supporting wind turbine operations, and drones have increasing potential to make a significant contribution. There are some areas in which more collaborative action could be beneficial in order to realise the potential benefits, as well as ensuring that UAS/UTM development does not become a source of further objections. The identified actions, as follows, therefore fall mainly under the stakeholder engagement strand.

- the integration of helicopter and drone operations in lower airspace is primarily an aviation issue to lead, coordinate and resolve. However, as a customer for helicopter and drone services, and because wind turbines can impact on the provision of those services, the wind industry should be involved, together with helicopter and drone operators, in a collaborative group addressing the surveillance challenge and other lower airspace topics (Action 14)
- the wind industry needs to be clearer about where its responsibilities lie as a customer of helicopter and drone services, rather than as a specialist helicopter or drone operator (Action 15)
- the wind sector needs greater engagement in UAS regulatory, airspace and UTM developments (Action 16)
- the issue of the CNS infrastructure in the offshore environment needs to be addressed collaboratively to realise the potential benefits of helicopters in providing integrated support to offshore wind (Action 17).

## 4.3. Lighting and Marking Resolution

The current incoherence and lack of consistency in lighting and marking is a wasted cost. Consistent lighting and marking requirements, based on a clear rationale, and evidence where available, would be safer and more cost effective for all stakeholders. There do not appear to be any strong political, technical or operational barriers to progress, so the identified actions, as follows, fall mainly under the stakeholder engagement strand.

- there needs to be greater clarity about aviation’s requirements for lighting and marking and the rationale for these requirements (Action 18)
- this should also take into account how demand-activated, or proximity-activated, lighting can reduce environmental impact and cost whilst still ensuring safety (Action 19)
- the wind sector’s role is primarily as an implementer of the lighting and marking requirements defined by each regulator. While the move to greater coherence and consistency will ultimately need to be agreed between the aviation and maritime sectors and their regulators, the wind sector has a strong interest in driving and enabling progress, and so needs to be engaged (Action 20).

## 5. CONCLUSIONS AND RECOMMENDATIONS

For the surveillance challenge, RenewableUK and the wind sector need to lead proactively, driving changes to policy and culture, providing the main inputs, and ensuring stakeholder engagement.

In relation to helicopters and drones, and lighting and marking, the wind industry is one of many stakeholders. In some aspects, such as the development of regulations and standards it will be for others (regulators and standards bodies) to take the formal lead. Nevertheless, RenewableUK and the wind sector need to ensure that the wind industry remains engaged and is able to contribute.

It is recommended that Renewable UK, working with other wind industry stakeholders such as OWIC and AIFCL, should:

- review, refine and if appropriate adopt the Action Plan presented in this report, integrating it into the RenewableUK work programme
- keep stakeholders informed and engaged, for example through events such as a regular Wind and Aviation workshops.

**Appendix A – Proposed Action Plan**

Strand	Action theme	Action No	Issue to address	Action	Outcomes (SMART if possible) <sup>1</sup>	Suggested lead	Coordination, resources, enablers	Consequences of inaction <sup>2</sup>
Political, structural and organisational	Engage government	1.	Lack of government lead, holistic approach and incentives for aviation to pursue improvements	<p>Present wind industry requests, rationale and realistic ways forward to government. Specific requests are that government should:</p> <p>a) Lead and drive all stakeholders to deliver an operating and surveillance environment that delivers both aviation and wind energy needs</p> <p>b) Engage at political levels (e.g. cross-departmental, local authority, regional, international) and in its work with other stakeholders to deliver this holistic approach.</p> <p>c) Strengthen policies on energy, planning and the environment, e.g. through updates to the Aviation Strategy, recognising that wind farms are now an essential part of the landscape. Move from seeing wind as a 'problem' for which wind should bear the cost, to aviation and its surveillance partners adapting their systems, supply chain and procedures. The policies should also acknowledge:</p> <ul style="list-style-type: none"> <li>- ATM infrastructure's reliance on sustainable power, that routing aircraft around windfarm clutter increases fuel use and emissions</li> <li>- increasing pressure on aviation concerning its environmental credentials and lack of progress – the sector's carbon emissions are still rising.</li> </ul> <p>d) Provide strategic policy guidance to CAA and NATS, and support to airspace users, aircraft and surveillance system manufacturers to enable all parties to agree technical requirements and deliver wind/aviation co-existence.</p>	<ul style="list-style-type: none"> <li>• Identify relevant government department(s) and individuals</li> <li>• New Aviation-Wind sector MOU signed</li> <li>• Present industry requests</li> <li>• Feed back to 2020 event</li> </ul>	RUK	<ul style="list-style-type: none"> <li>• Need a pan-government department structure of stakeholders</li> <li>• Need a revised Aviation MOU</li> <li>• Re-invigorated AAB under the AMB</li> <li>• Develop a strategy paper for RUK in taking forward issues with DfT and Government in general.</li> </ul>	<p>Continued unsatisfactory stresses between wind sector and aviation stakeholders.</p> <p>Reduced ability to achieve UK clean energy targets.</p> <p>Loss of UK export potential of innovative mitigation solutions.</p>

Strand	Action theme	Action No	Issue to address	Action	Outcomes (SMART if possible) <sup>1</sup>	Suggested lead	Coordination, resources, enablers	Consequences of inaction <sup>2</sup>
Political, structural and organisational	Facilitate a forum for government, aviation and wind leaders	2	Lack of holistic approach and incentives for aviation to pursue improvements	Facilitate an Executive Forum for government, aviation, surveillance and wind leaders with sufficient authority to agree and commit to aims, to make necessary resources available and to help drive government policy formation.	<ul style="list-style-type: none"> <li>• Convene the Forum</li> <li>• Agree ToRs / MoU</li> <li>• Hold at least one meeting with concrete actions assigned and completed</li> <li>• Agree and have contributed to a fund action plan total for 2020 - 2025</li> </ul>	Cabinet Office if willing, with e.g. RUK providing secretariat to minimise demands on CO.	<ul style="list-style-type: none"> <li>• Representative participants, with sufficient influence</li> <li>• (Some) funding and infrastructure for the organisation</li> <li>• Ideally, policies/ signals from government (see Action 1) should be in place first, as otherwise there is a danger that the Forum is limited to what the specific representatives can achieve amongst themselves, with little influence over government and wider industry. Despite this risk, however, the Forum should start up ASAP – indeed one of its aims should be to contribute to developing government policy</li> </ul>	<ul style="list-style-type: none"> <li>• Approaches to government (Actions 1) and other actions not adequately informed by the expertise and authority of key stakeholders and do not take account of their views.</li> </ul>
Facilitate technical and operational improvements	Baselining technical and operational ‘as is’ performance	3	Lack of tangible evidence of actual wind turbine impact on surveillance systems and airspace operators	Undertake a scientific review and measurement of the ‘as is’ technical impact on radars (receivers, processors, ground clutter and MTI filters, etc) that have windfarms in RLOS, ‘clutter’ that is displayed post processing, and any ‘operating load’ that ATM operators experience of this and other ‘clutter’ they have to deal with.	<ul style="list-style-type: none"> <li>• Technical review and measurement of all UK radars in RLOS of windfarms by end 2021.</li> <li>• Operational review and measurement of all ANSPs and MOD site STC/ATM/AD operator workload dealing with wind turbine clutter by 2021</li> </ul>	RUK to contract an Independent SQEP organisation	<ul style="list-style-type: none"> <li>• ANSPs, surveillance providers</li> <li>• Learn from other national approaches</li> </ul>	<ul style="list-style-type: none"> <li>• No baseline to establish ‘the problem’, and no baseline from which to measure improvement.</li> <li>• Continual disagreement over the actual impact of wind turbines on radars.</li> </ul>
Facilitate technical and operational improvements	Windfarm proposal and post construction assessment, reporting and monitoring methodologies and tools	4	Current methodologies and tools have not been nationally agreed, validated or assessed for decades and all use different databases, analysis, and assumptions. Thus, there is an inevitable disagreement of windfarms impact between sectors and stakeholders.	Undertake a scientific review and of current methodologies and tools used to assess RLOS, RCS, likely reflectivity, impact on radar performance, etc, of proposed and real-world windfarms. Improvements in computer analytics, processing power, RF propagation characteristics, terrain databases, RCS modelling, and SCADA data exploitation need to be reflected in modern windfarm proposal assessment methodologies and tools.	<ul style="list-style-type: none"> <li>• Review and report of the applicability of the major windfarm impact assessment methodologies and tools by end 2020.</li> <li>• Upgrade and evolution of windfarm impact on radar methodology and tools by mid-2021.</li> <li>• Adoption of nationally agreed approach to windfarm proposal and post windfarm construction assessment and monitoring strategy, methodology and tools.</li> </ul>	RUK to contract an Independent SQEP organisation	<ul style="list-style-type: none"> <li>• All windfarm assessment tool and service providers</li> <li>• ANSPs and MOD</li> <li>• Learn from other national approaches</li> </ul>	<ul style="list-style-type: none"> <li>• Continued disagreement on potential and actual impact of WFs on various radars</li> <li>• Reduced ability to achieve UK clean energy wind targets.</li> <li>• Loss of UK export potential of innovative mitigation solutions.</li> </ul>

Strand	Action theme	Action No	Issue to address	Action	Outcomes (SMART if possible) <sup>1</sup>	Suggested lead	Coordination, resources, enablers	Consequences of inaction <sup>2</sup>
Facilitate technical and operational improvements	Windfarm proposal scrutiny and approval	5	No consistent approach or impartial organisation that assesses, scrutinises and makes a SQEP decision on windfarm applications	Review how windfarm proposals are currently consulted upon, assessed, scrutinised and approved or objected to from an aviation perspective. Propose a more logical, consistent and fairer approach to UK windfarm proposal assessment and approvals/objections and post construction lifelong review and monitoring to constantly improve and evolve the process.	<ul style="list-style-type: none"> <li>Review and report of the applicability of the UK windfarm aviation consultation process by end 2020.</li> <li>Upgrade and evolution of windfarm impact on radar methodology and tools by mid-2021.</li> <li>Adoption of nationally agreed approach to windfarm proposal and post windfarm construction assessment and monitoring strategy, methodology and tools.</li> </ul>	RUK to contract an independent SQEP organisation	<ul style="list-style-type: none"> <li>UK planning Authorities</li> <li>UK aviation consultees</li> <li>Learn from other national approaches</li> </ul>	<ul style="list-style-type: none"> <li>Continued disagreement on potential and actual impact of windfarms on various radars</li> <li>Reduced ability to achieve UK clean energy wind targets.</li> <li>Loss of UK export potential of innovative mitigation solutions.</li> </ul>
Facilitate technical and operational improvements	Co-ordination and solution-sharing within wind industry	6	Mitigations are being accepted for specific wind applications, but this does not address the strategic need for a nationwide step change.	Set up a wind industry working group to ensure a more co-ordinated approach to mitigations between developers, encouraging sharing and acceptance of solutions.	<ul style="list-style-type: none"> <li>Convene the working group</li> <li>Agree working methods in outline</li> <li>Hold at least one meeting with concrete actions assigned and completed</li> </ul>	RUK to set up working group, drawing on expertise within Forum organisations	<ul style="list-style-type: none"> <li>Convening working group to be a specific task for the Forum</li> </ul>	
Facilitate technical and operational improvements	Realistic planning assumptions for aviation	7	At the same time as asking aviation to future proof its systems, wind has a responsibility to better articulate potential developments in wind turbine and windfarm design, such that aviation can work to realistic assumptions.	Define realistic planning assumptions for aviation to work to – e.g. on turbine height, turbine dimensions, types and materials, numbers, zoning, EMI/EMC impacts (see Action 8 for more detail)	<ul style="list-style-type: none"> <li>Convene a study group</li> <li>Agreed scope and outputs of study, and how / from where information will be gathered</li> </ul>	RUK to set up group drawing on expertise within Forum organisations	<ul style="list-style-type: none"> <li>Convening study group to be a specific task for the Forum</li> </ul>	<ul style="list-style-type: none"> <li>Aviation industry unable to make realistic plans to accommodate wind farms</li> </ul>
Facilitate technical and operational improvements	Windfarm/ wind turbine design to avoid clutter	8	Wind turbines/ windfarms not designed to facilitate clutter resistance	Assess potential for low EMI / high EMC WT designs to help surveillance systems improve their clutter resistance	<ul style="list-style-type: none"> <li>Scope the study</li> <li>Secure funding if required</li> <li>Appoint study group/ researchers</li> </ul>	RUK to set up study group drawing on expertise within Forum organisations. BEIS input was suggested. Or could this be eg an ORE Catapult task? Not just an offshore issue. Or an international one (Wind Europe?)	<ul style="list-style-type: none"> <li>Scoping and appointing suitable group to be a specific task for the Forum</li> <li>BEIS willingness</li> </ul>	

Strand	Action theme	Action No	Issue to address	Action	Outcomes (SMART if possible) <sup>1</sup>	Suggested lead	Coordination, resources, enablers	Consequences of inaction <sup>2</sup>
Facilitate technical and operational improvements	Requirements, metrics and criteria	9	Lack of understanding of aviation requirements, metrics and criteria for impact of wind turbines	Set up wind/ aviation / surveillance working group to develop metrics and criteria for assessing wind turbine/ windfarm impacts against aviation requirements	<ul style="list-style-type: none"> <li>• Convene the working group</li> <li>• Agree ToRs / MoU</li> <li>• Hold at least one meeting with concrete actions assigned and completed</li> </ul> <p>Later – this may lead e.g. to suggestion for a national, independent test and certification facility which is accepted by all parties. Funding?</p>	RUK	<ul style="list-style-type: none"> <li>• Convening working group to be a specific task for the Forum</li> </ul>	
Facilitate technical and operational improvements	National wind turbine, windfarm and surveillance EMI/EMC assessment, testing and certification facility	10	Lack of a national approach and EMC certification approach or facility reduces the ability to have a consistent approach or validation of low EMI and high EMC wind turbine and radar designs and deployment	Review how other nations take a more consistent and strategic view of developing agreed low EMI and high EMC radar mitigations and future designs. Propose a more strategic and nationally consistent approach to providing central, impartial, wind turbine/surveillance R&D, test, validation and accreditation of low wind turbine EMI and high surveillance EMC designs.	<ul style="list-style-type: none"> <li>• Review report of how other nations encourage, incentivises, or legislate for low EMI wind turbines and high EMC radars by mid-2020</li> <li>• Proposed UK approach report by end 2020.</li> </ul>	RUK to contract an independent SQEP organisation	<ul style="list-style-type: none"> <li>• Wind turbine designers</li> <li>• Radar/surveillance designers</li> <li>• Learn from other national approaches</li> </ul>	
Facilitate technical and operational improvements	National low airspace surveillance strategy	11	Lack of a national low airspace surveillance strategy for the challenges of the 21 <sup>st</sup> century low airspace users. Activity has focussed on only one problem – wind turbines	Review the wider UK surface-to-upper airspace challenges from 2020 to 2050 to generate a UK airspace surveillance and governance strategy to drive the development of new performance criteria for updated and new surveillance systems that can meet all likely UK airspace challenges from ‘ground to space’ for the 21 <sup>st</sup> Century. Set up aviation surveillance working group to develop metrics and criteria for aviation surveillance performance requirements and criteria for all likely airspace users, including: low level personal air transport; drones, balloons and UASs; ground-based, floating and airborne wind turbines; helicopters; enduring flight low orbit satellites and aerostats; space launches and recoveries; recreational, commercial and military aircraft; low RCS aircraft; hyper-sonic flight; extreme weather; more 0-1000ft ground based clutter, greater airspace traffic and activity.	<ul style="list-style-type: none"> <li>• Review report of how other national future airspace surveillance and ATM strategies to 2050 and beyond by mid-2020</li> <li>• Proposed UK approach report by end 2020.</li> <li>• Study of likely future airspace use and users</li> <li>• Review and evolution of airspace surveillance performance criteria to enable safe and secure use of airspace by manned and unmanned air systems.</li> </ul>	RUK, supporting DfT, MOD and an independent SQEP organisation	<ul style="list-style-type: none"> <li>• Radar/surveillance designers</li> <li>• CAA, NATS, Met office and MOD</li> <li>• Learn from other national approaches</li> <li>• All likely airspace users from ground to space</li> </ul>	<ul style="list-style-type: none"> <li>• Current and planned surveillance systems unlikely to cope with and provide safe and secure airspace requirements beyond 2025</li> </ul>
Stakeholder engagement	CAA	12	CAA supportive but constrained by lack of direction from government (DfT). Consequently, wind turbines are not addressed in future airspace architecture, surveillance strategy or CNS requirements.	Engage with CAA to include wind fully in development of their airspace, surveillance and CNS strategies.  Also, this issue seems to fall between the gap between wind sector deal and aviation sector deal. Is there a place for a national surveillance sector deal?  Coordination of benefits from aviation infrastructure developments to also benefit resolution of aviation/ wind turbine issues – this will require proactive engagement in development of airspace architecture, surveillance strategy, electronic conspicuity, etc.	<p>? (what is realistic to achieve will flow down from Actions 1 and 2)</p> <p>Proactive engagement with DfT, CAA and ANSPs</p>	RUK	<ul style="list-style-type: none"> <li>• Policy signals from government (Action 1)</li> </ul>	

Strand	Action theme	Action No	Issue to address	Action	Outcomes (SMART if possible) <sup>1</sup>	Suggested lead	Coordination, resources, enablers	Consequences of inaction <sup>2</sup>
Stakeholder engagement	GA, airports, technical specialists ...	13	Wind not yet accepted as new normal	Wind industry presence at e.g. GA or airport events / exhibitions, technical surveillance conferences ...  Airports and smaller ANSPs were under-represented at the NEC event and ways need to be found to engage them more effectively (e.g. via AOA?).	Appropriate sectors to have taken the lead for wind turbine EMC surveillance systems, low airspace operations around windfarms, wind turbine marking and lighting conformal with other land and maritime obstruction requirements. Airports and smaller ANSPs engaged.	RUK?		
Stakeholder engagement	Helicopters and drones	14	Integration of helicopter and drone operations in lower airspace	This is primarily an aviation issue to lead, coordinate and resolve. However, as a customer for helicopter and drone services, and because wind turbines can impact on the provision of those services, the wind industry should be involved, together with helicopter and drone operators, in a collaborative group addressing the surveillance challenge and other lower airspace topics	Needs further consideration taking account of actions already in progress e.g. RUK RUGO, G+ Helicopter Guidance.	RUK		
Stakeholder engagement	Helicopters and drones	15	Wind industry responsibilities	The wind industry needs to be clearer about where its responsibilities lie as a customer of helicopter and drone services (rather than as a specialist helicopter or drone operator)	Needs further consideration taking account of actions already in progress e.g. RUK RUGO, G+ Helicopter Guidance.	RUK		
Stakeholder engagement	Helicopters and drones	16	Realising the benefits of UASs	The wind sector needs greater engagement in UAS regulatory, airspace and UTM developments	Involvement in NATS and other UAS-related forums?	RUK		
Stakeholder engagement	Helicopters and drones	17	Adequacy of CNS infrastructure in the offshore environment	The issue of CNS infrastructure in the offshore environment needs to be addressed collaboratively to realise the potential benefits of helicopters in providing integrated support to offshore wind.	Involvement in NATS forums?	RUK		<ul style="list-style-type: none"> <li>• Inadequate CNS infrastructure to support offshore heli and drone ops</li> </ul>
Stakeholder engagement	Lighting and marking	18	Clarity of and rationale for lighting and marking requirements	There needs to be greater clarity about aviation's requirements for lighting and marking and the rationale for these requirements	Engagement with CAA and in the development of the IEC standard on lighting & marking. Liaison with international groups eg Wind Europe.	RUK		<ul style="list-style-type: none"> <li>• Lighting and marking requirements not optimised for safety and cost</li> </ul>
Stakeholder engagement	Lighting and marking	19	Realising benefits of demand-activated, or proximity-activated, lighting	Clarification of requirements and rationale should take into account how demand-activated, or proximity-activated, lighting can reduce environmental impact and cost whilst still ensuring safety	Engagement with CAA and in the development of the IEC standard on lighting & marking. Liaison with international groups eg Wind Europe.	RUK		<ul style="list-style-type: none"> <li>• Inefficient use of energy</li> </ul>
Stakeholder engagement	Lighting and marking	20	Wind industry role in driving and enabling progress towards more coherent and consistent requirements.	Wind's role is primarily as an implementer of the lighting and marking requirements defined by each regulator. While the move to greater coherence and consistency will ultimately need to be agreed between the aviation and maritime sectors and their regulators, the wind industry has a strong interest in driving and enabling progress, and so needs to be engaged.	Engagement with CAA and in the development of the IEC standard on lighting & marking. Liaison with international groups eg Wind Europe.	RUK		<ul style="list-style-type: none"> <li>• Wind industry's interests not taken into account</li> </ul>

Notes:

1. To be achieved by next RUK Wind & Aviation event (spring 2020?) except where otherwise noted.

2. In several cases, the content of this column would be the same as that of 'Issue to address'. Only completed where there is something to add, or clarify.

**Appendix B – Proposed Action Plan Timeline**

ACTIVITY	Related Action Plan item numbers	2019	2020				2021				2022				2023				2024				2025			
		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Agree Action Plan		█																								
Engagement with UK government departments		█	█																							
Lead Government Department nominated				█																						
MOU refreshed and revitalised				█	█																					
MOU signed by all stakeholders				█	█																					
First Ministerial led meeting				█	█																					
Develop draft 5 year action plan				█	█	█																				
Review of UK and overseas WF proposal assessment, analysis, scrutiny and approvals/objection processes, methodologies, tools				█	█	█																				
Review and benchmarking of UK and overseas of airspace infrastructure, airspace control regulations, radar user and ANSP WF challenges				█	█	█																				
review, measurement and benchmarking of UK and overseas surveillance system technical interference challenges from WTs in RLOS				█	█	█																				
review, measurement and benchmarking of WT and WF design, construction and EMI measurement and metrics				█	█	█																				
develop R&D and modern approaches to WF proposal assessment, analysis, scrutiny, certification and approvals/objection processes, methodologies and tools for use in the UK, and available for use abroad						█	█	█	█																	
develop proposals for UK and overseas airspace infrastructure, airspace control regulations, surveillance system user, and ANSP operational changes to cope with future airspace challenges by Dec 2022						█	█	█	█	█	█	█	█													
develop R&D and technical design, construction and layout solutions for low interference WTs and WFs						█	█	█	█	█	█	█	█													
develop R&D and interim technical solutions for more interference resilience of current radars and surveillance systems						█	█	█	█	█	█	█	█	█	█	█	█									
develop R&D and enduring future technical solutions for a wide spectrum of complex target and complex clutter interference resilience of updated and new radars and surveillance systems						█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Low EMI WTs deployed															█	█	█	█	█	█	█	█	█	█	█	█
high EMC complex target and complex clutter resilient and tolerant surveillance systems, from 'surface-to-space', deployed															█	█	█	█	█	█	█	█	█	█	█	█









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future energy system, powered by clean  
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