The EU ETS has forced airlines to monitor and record fuel burn data in ways they have never had to before. Tonne-kilometre reports were filed in 2011, but annual emissions reports are required by the EU. Airlines must comply or face strict financial penalties. This article assesses the practicalities of recording fuel burn and operational data.

The practicalities of recording ETS data

Since the European Union (EU) legislated to include aviation in the emissions trading scheme (ETS), airlines have been working to comply.

The EU ETS will include all flights into and out of the EU, as well as all intra-European flights, and will therefore affect the majority of airlines flying within the EU. Small aircraft and airlines operating only 970 flights per year, or emitting less than 10,000 tonnes of CO2, are exempt.

To comply with the EU ETS, operators have to record their emissions on a per-flight basis, and submit these figures to the EU by 31 March every year. The data must first be independently checked and verified, before each operator is allocated its free emissions allowances, which are effectively an annual quota of carbon emissions.

Operators must pay for all additional carbon emissions. In 2012, free allowances account for 85% of an operator's 2010 emissions, while 15% must be paid for. The free allowance will drop to 82% of 2010's emissions from 2013-2020. The remaining 18% of emissions will have to be paid for.

The EU will keep the 3% of carbon allowance achieved from reducing the free allowance from 85% to 82% for allocation to new airlines, and existing operators with high growth rates.

Because the percentages for free allowances are calculated according to emissions during the base year of 2010, they do not provide any capacity for airline growth or development. Airlines will therefore have to pay proportionally more for carbon emissions allowances if they want to continue to grow. Airlines will be forced to buy additional allowances, over their free quota, in auctions. The price of each allowance will therefore be determined by market forces, which frequently change.

The practicalities of recording fuel burn and operational data for the purposes of ETS reporting are explored here. What is required, the systems used, and the problems incurred are all examined.

Data requirements

Since fuel is now typically the largest single cost to any airline, many airlines had fuel burn recording systems in place before aviation was introduced into the EU's ETS. The EU's ETS, however, has introduced new data requirements for fuel burn, with reports due annually in a standardised EU reporting format.

"Many airlines were recording fuel burn data before the introduction of the EU ETS, but none had it in the required format," says Aaron Robinson, senior implementation consultant at OSyS. "This means that airlines had to change or adapt existing fuel burn recording systems for ETS, or implement new systems solely for the purpose of ETS data reporting."

There are two types of reports required by the EU. First is a tonne-kilometre (TK) report, which was submitted by all applicable airlines on 31 March 2011. This was required by the EU only once for each operator, and represents the payload carried through the calendar year of 2010. This formed the basis of the free carbon allowances allocated in 2012 for compliant airlines.

The second type of report required is the annual emissions (AE) report, also due by 31 March each year. This is the only report required by the EU on an annual basis, and shows all carbon emissions made by an operator during the previous calendar year.

"The TK report for the year 2010, filed in March 2011, required more data than the AE reports," says Rudolf Christen, chief executive officer at Aviaso. "The TK report required components of weight and distance, whereas the current AE reports focus just on fuel consumption."

All TK reports were filed with the EU in 2011, so only the AE reports need to be focused on here. Since data are required on an individual flight basis, and cannot be summarised into groups of flights, a significant quantity of data is still required by each operator to compile these reports.

The data required for collection, however, depend on the method used to calculate fuel emissions. "Under complex reporting, the EU allows for two different methods to calculate emissions produced for each flight," says Denis Quinn, director of support services at ETS Aviation. "These are labelled Method A and Method B. Method B appears to be the preferred option, with all but one of our 130 customers using Method B."

Under complex reporting, the calculations are similar, but measure the fuel used at different points in time. "Both methods take the fuel uplift for a flight, and add the difference between two identical points in time in consecutive flights," says Robinson. "This is either the fuel level after fuelling has been completed, or upon arrival."

Method A takes the fuel level in the tanks once fuel uplift for a flight is complete. The fuel level is taken again once fuel uplift for the next consecutive

flight is complete, and this figure is subtracted from the fuel level after fuel uplift for the first flight. The fuel uplifted for that same next consecutive flight is then added to this. This gives fuel consumption for the first flight under Method A.

Method B is simpler to understand and calculate. Method B takes the fuel remaining in the tanks at the end of the previous flight, and fuel uplift for the current flight is then added. The fuel in the tanks at the end of the current flight is then subtracted, to give a final figure for fuel consumption under Method B.

The EU, however, does add further complications for its emissions reports, so that more calculations are required to show the emissions for any given flight. Robinson explains, "Emissions depend on fuel mass, but because fuel suppliers invoice based on fuel volume and not mass, the fuel density has to be recorded."

Fuel density is not a value that is universally available from fuel suppliers worldwide, so this requirement has presented a challenge to airlines in their ETS data reporting. "Fuel density allows the fuel uplift volume to be converted to mass," says Guido Harling, chief executive officer and lead auditor at ETS data reporting. "Fuel density varies according to the types of jet fuel used, and differs in hot and cold weather. Given that fuel density values are not always readily available, airlines face several problems in accurately reporting consumed fuel mass."

The EU does, however, legislate for missing fuel density data. "In cases where fuel density is missing or unobtainable for any given flight, the EU allows airlines to use a default fuel density figure of 0.8 kilograms per litre (kg/l) for Jet A1 fuel," says Quinn. "The fuel uplift in volume multiplied by the density gives the fuel uplift in weight. The fuel used for the flight is multiplied by a factor to calculate the emissions."

In all, therefore, several data fields must be completed for each flight that an airline operates. This is compiled into the AE report to be submitted to the EU.

"Several items are required in the AE report," says Christen. "Standard data required include the identification of the operator and verifier, as well as reference to the approved Monitoring Plan. Aircraft data with a list of all aircraft used during the reporting year must also be shown. Total emissions must then be listed for each fuel type used. It is important that emissions from all wet-leased flights are also recorded, which can be quite difficult to collect and cross-check," continues Christen. "Finally, all the emissions have to be grouped by member states, and even by aerodrome-pairs."

Data collection

To comply with the EU's ETS, and submit the AE reports, airlines must have efficient data collection systems in place to handle and process the large volumes of data.

The nature of these systems, however, depends on the size of the airline. "A small airline with only a small number of ETS-applicable flights, may manually process the required data using tools such as Excel," explains Christen. "A medium-sized airline may have a more automated process, but it will require some manual input. Large airlines, however, typically automate the entire process, with little manual interaction at all. The exception to this is, of course, any validation errors that are made, which may require manual processes to resolve," says Christen.

The reason for these differences is to do with both practicality and cost. There are several IT systems available that can automate the entire process, but these require significant investment. For a small airline, this investment may not be practical and the manual option is preferable. A large airline would have significantly more data, and therefore a manual process may not be practical, or feasible. A large airline is also more likely to have the resource base to invest in an automated ETS IT system.

The cost to an airline of ETS data reporting can also depend on the airline's attitude towards ETS. "The cost depends largely on the effort that an airline makes," explains Robinson. "An airline could go to the effort of automating its ETS work, creating long-term savings in exchange for a large upfront cost, or an airline could also just report enough to get by, or try to improve the quality of its report and reduce its emissions costs." There are different ways, therefore, in which an airline can approach complying with the data requirements for the EU ETS.

Many large airlines with significant numbers of ETS-applicable flights have mostly automated data processing in place. With automated systems, data are taken automatically from flight management systems (FMS) and/or from

The EU allows two methods for calculating the emissions produced for each flight. The two methods use different points in time to measure the fuel used. Emissions also depend on fuel mass, and this complicates calculations.

the aircraft communications addressing and reporting system (ACARS). ACARS can also be used to transmit manually-entered data more efficiently. "The most effective way to capture fuel levels on the aircraft is through automatic ACARS reporting," says Robinson. These data from the aircraft must then be combined with fuel data from invoices.

"Fuel invoices are usually tracked separately, so data integration is required to combine all the necessary elements," continues Robinson. The data are then integrated and processed through internal or outsourced IT systems, into the correct format for EU ETS reports.

One example of this is British Airways. "Rising fuel costs were a large incentive to be fuel-efficient, even before the EU ETS was introduced, so fuel burn and operational data were already important to us," says Andy Kershaw, manager environmental policy at British Airways. "To comply with the EU ETS, our existing fuel burn recording systems were built on and modified. Data from different systems had to be aligned to meet the requirements of the EU ETS, and the system is largely automated."

Another airline with automated data collection processes is Finnair. "At Finnair, we have such a new fleet that we get fuel burn figures directly from the aircraft systems," says Kati Ihamaki, vice president sustainable development at Finnair. "The data are monitored and collected from every flight, verified and reported once a year and sent to the reporting authority and EU." Operating a newer fleet of aircraft will therefore make it easier to link aircraft systems to IT systems on the ground for ETS reporting purposes.

The overall process for ETS reporting is the same for any airline, however, regardless of size, fleet and resources. Data must be collected, whether it is manually or automatically, and then processed into the correct format for the EU ETS. This must then be validated and verified, with data gaps and errors reconciled, before final submission to the EU. The EU ETS also requires that airlines store and archive data for the previous 10 years.

In any given airline, several departments may be involved in data collection, and processing and submission of AE reports. "The two main areas involved are: the airline's IT department, which establishes databases and reporting; and flight operations and/or the fuel department, which compiles the reports, checks the work, and communicates with the relevant competent authority," explains Robinson.

Apart from these business areas, other departments within an airline may also play a role in recording fuel burn data for ETS reporting. "At Finnair, we have several departments involved: flight operations, IT systems, accounting, environment, and treasury," says Ihamaki. "These different parties and departments need to co-operate with each other and report the data in a specified way."

Departments such as finance and accounting are needed in the ETS data reporting process because fuel receipts from suppliers play a role in data entry on fuel uplifted, as well as validating and checking fuel uplift data already recorded. Finance departments will also be involved further once the financial obligations of the EU ETS come into effect in 2013, so that allowances and any financial penalties incurred can be paid for.

Depending on the size of the airline, some may have environmental departments responsible for overseeing the entire process, while others may add these responsibilities to personnel in other departments, such as flight operations or fuel departments. LOT Polish Airlines, a mid-sized European airline operating approximately 300 flights per day, has created a special department for ETS. Andrzej Rode, head of environmental affairs at LOT, explains: "Responsibilities were shifted from other departments to create a special four-person department, responsible not just for ensuring ETS compliance, but all environmental issues at LOT. EU ETS processes account for about 60% of the workload."

LOT also has several manual processes still in place. "In terms of recording day-to-day fuel burn, most of the processes are not automated," says Rode. "Hand-written reports are taken from both the flightdeck and from fuel suppliers. Data are then entered into the system, before being converted to EU standards for the AE report."

"Flight data are processed about three days after the flight has taken place, with a constant flow of documents coming to the department as flight operations occur," adds Rode.

As with all manual processes, typing, human and other errors occur. "To maintain accuracy, mistakes must be found and rectified before the report is submitted," continues Rode. "It is very time-intensive to identify mistakes, because often fuel suppliers must be contacted directly for the data to be reconciled."

LOT does anticipate that its processes for ETS data reporting will become more automated in the future, however. "Soon electronic flight bags (EFBs) will be introduced to the newer aircraft in the fleet, which will lower the number of paper documents required because fuel burn data can be downloaded directly to the IT system," says Rode. This will reduce the manual workload for ETS data reporting.

Fuel and emissions data can be taken automatically from the flight management systems and from the ACARS. The data can then be transmitted to ground stations using ACARS.

Data problems

Whether an airline has more manual or automatic processes in place, a number of problems can occur in recording fuel burn and operational data for ETS reporting. "A big issue with ETS is data quality - or simply put, the 'garbage in/garbage out' principle," says Christen. "If poor or incomplete data are used, then the reports will be incorrect, resulting in airlines not meeting the EU's high data accuracy requirements.

"Various issues can lead to inaccurate or incomplete data entering the system. Manual processes run the risk of typing errors, while at other times entire flights might be missing," continues Christen. "Fuel density availability and correct identification of exempted fuel usage can also be issues."

This shows that there are a variety of problems that can occur in data collection and processing. Robinson summarises: "There are three main problems: data availability; data quality; and data integration. A lack of available data means that there is insufficient information to calculate emissions for ETS reporting. Data of poor quality can in some cases be worse than having no data at all, since the problem may be difficult to recognise and/or correct. Finally, data will be coming from many sources, so proper data integration to ensure that a data set is correct is critical to ETS reporting."

When problems occur, it is vital that operators find ways to correct them, to ensure they meet the EU ETS standards. "The key is to get the relevant flight and fuel consumption data from the cockpit into the ETS report. But even the most sophisticated electronic systems sometimes fail to record data. Therefore back-up systems and methods can be used to verify and validate data, and to correct errors," says Harling. "One failsafe option is using the aircraft's technical log to verify and check data. If this is not available, all operators can use Eurocontrol data, which tracks every flight into EU airspace. Fuel receipts and invoices from the fuel supplier can also be used.

"For fuel density problems, a standard fuel density value of 0.8 kg per lite (kg/l) can be used as a back-up option to calculate emissions, with all its inherent inaccuracies. If entire flight records are lost or unavailable, the small emitters tool can be used to bridge this data gap. This tends to overstate emissions, however, so airlines and the EU both prefer to use the actual values," continues Harling. "Overstating emissions is better than nothing, however, and sometimes airlines must do this to comply."

Despite the high quantity and quality of data required for ETS data reporting and the associated problems with this, the ETS has in some cases helped airlines. This is because the ETS has driven these airlines to better track and further reduce fuel consumption, thereby increasing fuel efficiency and lowering their operating costs. "The ETS has brought about a level of data recording that was not there in the past," says Quinn. "It has helped to standardise and improve data recording and raise awareness of fuel usage and emissions output throughout the airline industry."

Christen agrees. "The ETS has forced airlines to start improving fuel efficiency. This helps airlines save fuel, and therefore money, which means that the ETS is not only a cost factor to airlines."

This is echoed by Harling, who states, "The ETS has made for better airlines. It has helped to make them more efficient by using less fuel, and so help reduce their operating costs."

IT systems

For data to be processed into the required format, some airlines use their own in-house systems. These systems have often been developed from systems used to record fuel burn data pre-ETS. For airlines that do not wish to develop their own in-house IT systems for ETS data reporting, several IT suppliers can supply systems for this purpose. Some of these are sold to the airlines to run themselves, and others are fully outsourced with the IT systems supplier responsible for the whole process.

Aviaso provides one such system, with its EU ETS software. This software automates the entire ETS process, including data collection and validation, and compliant data reporting. "Our software connects directly to an airline's IT systems," says Christen. "Aviaso/EU ETS comes with ready-made data import adapters for most of the major airline IT systems."

The Aviaso software automatically validates the data and checks for possible errors. "To ensure high quality data, our software includes more than 50 validations and cross-check routines," continues Christen. Besides all officially required reports, many further reports such as audit or carbon account reports are available. Many of Aviaso's clients use not only the EU ETS software, but also Aviaso's fuel efficiency software.

Another such company in the market is ETS Aviation, which offers its ETS Aviation Footprinter TM. "Data are uploaded in bulk, via a web service or manually, into the system according to the operator's requirements," says Quinn. "ETS Aviation Footprinter TM automatically looks for gross errors in fuel use and data gaps. Once errors are reconciled, reports are electronically generated for verification and submission to the authorities." ETS Aviation Footprinter TM is often used in conjunction with Aviation Fuelsaver TM,

The complexities of the type and volumes of data required for EU ETS compliance requires the use of specialist IT systems for airlines with large operations.

a fuel efficiency software provided by ETS Aviation.

OSyS provides another solution to the market with its ETS monitoring, reporting and verification (MRV) software. "MRV is an add-on to our main fuel efficiency software," says Robinson. "Our MRV solution integrates data from aircraft reporting and fuel invoicing systems, as well as other databases. Data are processed with error checks before the report is submitted."

Apart from automating the data processing and reporting process, OSyS is investigating further enhancements and uses for its ETS solution. "Forecasting future emissions would be quite useful. This would help airlines more accurately forecast their budget for ETS requirements, helping with cashflow forecasts," says Robinson.

Airpas Aviation is another company on the market, with its eMission product. "We already provided software for managing direct operating costs, such as fuel and navigation costs, where data from the FMS and other systems were already electronically transferred to a database," says Gerd Schnitzler, senior consultant at Airpas Aviation. "We then enhanced this solution to include ETS and the subsequent extra analysis and costs."

Complying with ETS data reports is not the only solution provided by the eMission product. "Besides the legal reporting functionalities, including checks for data completeness and correctness, we provide certificate allowances software to give airlines solutions on the best allocation of carbon allowances," says Schnitzler. This would help airlines to buy the correct amount of allowances beyond their free allocation.

The solutions discussed previously have focused on medium to large airlines that have not developed their own in-house IT systems for ETS data reporting. Aviation Experts provides some reporting services for small airlines that still need to submit EU ETS reports.

"Airlines send us fuel burn and other ETS-relevant data to file EU ETS reports," says Christian Lambertus, managing partner at aviationexperts. "These are small operators with five aircraft or fewer. The input data comes from technical logs on paper and is processed on an excel spreadsheet. Data checks are carried out before the report is submitted to the EU."

Despite having a small fleet, and a relatively small number of flights, some airlines still wish to outsource the work of ETS compliance. Lambertus explains, "A small operator would want to outsource this work, since it is unlikely to want to hire new people just for ETS, or to increase the workload on its current labour force," says Lambertus. "This ensures that employees concentrate on running the airline, rather than adding further responsibilities to deal with EU ETS compliance."

Summary

The EU ETS has added a significant burden onto airlines to comply with its stringent data requirements. Airlines have a variety of options open to them in terms of producing AE reports, depending on the airline's size, resources and organisation. Some airlines have simply developed their own in-house systems, derived from previous fuel data recording systems, whereas others have completely outsourced. The degree of manual interaction or level of automation also depends on similar factors of airline size and resources.

For airlines to minimise their long-term outlay on ETS data reporting, automating the process through IT systems will be the way forward. "IT systems can greatly help in ETS reporting. They ensure greater accuracy, and lower the on-going costs of ETS data compliance," says Harling.

One development in particular that may affect EU ETS data compliance is the development of biofuel. "Under the EU ETS, biofuels are categorised as generating no emissions," says Robinson. This is a potential benefit to airlines, because with widespread biofuel use, EU ETS costs would decrease. It is not as simple as this, however.

"Airlines maintain common fuel infrastructure at airports worldwide. The EU requires flight-by-flight accounting of all fuels, so use of biofuel would require airlines to maintain separate, but identical, sets of infrastructure, pipelines, and storage tanks, which is not financially viable. Fortunately, the EU is aware of this concern and is working to address it in future legislation," adds Robinson.

Another problem with biofuel at its current stage of development is that although it is considered emissionless, the fact that it costs more than regular jet fuel makes it prohibitive for airlines to use in an economically feasible way. Some jet fuels are biofuel blends, but it is unclear what level of emissions they produce.

Until biofuels become more economically feasible, therefore, current ETS data requirements are likely to remain the same in the short to medium term. Although airlines differ in terms of size and resource base, most are likely to phase out manual processes from ETS data reporting, and adopt automated processes for ETS data compliance, if they have not already done so. This will be aided by the further introduction of EFBs, as well as the arrival of new generation aircraft such as the A320 neo, A350, 737 MAX, and 787 in the coming years. AC