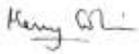
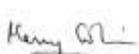
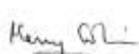


SHETLAND INTER-ISLAND TRANSPORT STUDY

Environmental Working Paper
(Vessels and Aircraft)



Quality Management

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1 Context – Shetland Islands Council Carbon Management Plan

A brief review of the Council's Carbon Management Plan¹ has been undertaken. The key issues and findings in the plan of relevance to the Transport Study are summarised below.

- The plan includes breakdowns of baseline energy consumption by sector and fuel type for the Council including ferries and tugs for 2007/8 and 2013/14 (Section 3.20). Out of a total baseline energy consumption² of 114,575,959kWh per annum, tug operations³ accounted for 15,142,349kWh (13% of total SIC energy use) and inter-island ferry operations used 47,774,362kWh (42%).
- By 2013/14 the energy consumption figures had fallen across the SIC estate to 97,366,754kWh and energy use in this year was 8,558,737kWh for tugs (9% of total) and 45,597,547kWh (47%) for ferries⁴.
- The Council has reduced its overall carbon emissions by 15% since 2007/8 which is attributed to some downsizing of staff numbers and resource efficiency measures.
- Carbon emissions (tonnes CO₂) from combustion of transport oil for tugs and ferries⁵ reduced from approximately 17,000t in 2007/8 to approximately 14,000t in 2013/14 although the causes of the reduction are not discussed.
- The Strategy makes reference to the adoption of a new Scottish Government carbon accounting tool to be introduced in 2015 for all local authorities and presents a graph of hypothetical emissions savings for a proposed Hydrogen Ferries project.
- Appendix 1 includes an action plan which incorporates an action relevant to the study (Number 15) to review ferry fuel use.
- Appendix 4 presents a Carbon Projects Register. Reference is made in this appendix to an ongoing project which states 'reduce age profile of fleet – ongoing'. It is not stated whether this refers to the Council's vehicle fleet and/or ferry fleet.

Overall the Carbon Management Plan sets out the Council's aspiration to reduce carbon emissions in line with those set nationally by Scottish Government, that is to reduce emissions by 42% from 2007/8 levels by 2020. Taking account of the actual change in SIC emissions between this baseline year and 2013/14 (on average 2.68% per annum over this period), the required annual carbon reduction to fully meet the target is 4.53% over the six years from 2014 to 2020. As a signatory to the Scottish Climate Change Declaration in 2008, the Council is also committed to the longer term national target of an 80% reduction in emissions by 2050.

¹ Shetland Islands Council Carbon Management Strategy Carbon Management Plan 2015 – 2020 April 2015

² Baseline energy consumption was the average over the 3 years 2005/6, 2006/7 and 2007/8

³ Tug operations do not fall within the scope of the Shetland Inter-Island Transport Study

⁴ There is no reference to emissions from inter-island flights

⁵ Data are not disaggregated for tugs and ferries

2 Vessels and Aircraft Fuel Efficiency and Baseline Emissions

2.1 Ferry Fuel Use and Emissions

SIC has provided a detailed breakdown of budgeted fuel use for each vessel in the ferry fleet for the period from April 2014 to March 2015. The table below summarises the data by vessel and for the whole 12 month period reported.

Table 2.1 - Budgeted Ferry Fuel Use 2013-2014

Vessel	12 Month Fuel Use (Litres)
Bigga	312,451
Dagalien	864,408
Daggri	812,122
Filla	419,776
Fivla	202,285
Geira	216,217
Good Shepherd	34,370
Hendra	310,925
Leirna	181,720
Linga	823,372
Snolda	24,058
Thora	16,050
Grand Total	4,217,754

Using an emissions factor of 2.727kg CO₂ per litre of marine gas oil⁶, the total fuel used by ferries in the annual period shown above equates to total carbon dioxide emissions from the ferry fleet of 11,502 t CO₂ in 2013/14.

2.2 Aircraft Fuel Use and Emissions

The BN2 Islander engines burn Avgas (aviation gasoline). This is an aviation fuel used in spark-ignited internal-combustion engines to propel aircraft. Some grades of Avgas still contain tetraethyl lead (TEL), a toxic substance used to prevent engine knocking (detonation). There is ongoing worldwide research aimed at eventually reducing or eliminating the use of TEL in Avgas.

Avgas has an emission coefficient (or factor) of 18.355 pounds CO₂ per U.S. gallon (2.1994 kg/l) or about 3.05 units of weight CO₂ produced per unit weight of fuel used. The main petroleum component used in blending avgas is alkylate, which is essentially a mixture of various isooctanes. Some refineries also use reformate. All grades of avgas that meet CAN 2-3, 25-M82 have a density of 6.01 lb/U.S. gal at 15 °C, or 0.721 kg/l. (6 lb/U.S. gal is commonly used for weight and balance computation).

There are two BN2 Island aircraft serving the Inter island service:

- G-SICA has 2 x Lycoming IO-540-K1B5 piston engines and G-SICB has 2 x Lycoming O-540-E4C5 piston engines. The Lycoming O-540 is a family of air-cooled

⁶ Emission factor from DEFRA Emissions Conversion Factors for dataset year 2014, <http://www.ukconversionfactorscarbonsmart.co.uk/>. The DEFRA Methodology Paper which accompanies the emissions factor dataset identifies that the category of 'Gas oil' includes marine gas oil

six-cylinder, horizontally opposed fixed-wing aircraft of 541.5 cubic inch (8,874 cc) displacement, made by Lycoming Engines; and

- the O-540 version is a standard, direct-drive, normally aspirated opposed engine, equipped with a carburetor, whilst the IO-540 is a normally aspirated engine with fuel injection, which schedules fuel flow in proportion to airflow.

These engines produce either 260 or 300 horsepower with the fuel injection version. They burn fuel at different rates and also fuel burns at different rates when taxi-ing and when flying. On some of the Shetland routes the taxi-ing is a significant portion of the burn. It is thus difficult to accurately report fuel burn because of the complexity of factors involved. Internet research reports rates for different purposes (eg flight planning, sales claims, accident investigation) as being between 120 and 135 litres / hour.

The total flying time on the Inter Island Service has been estimated as 600 hours per year, and the two aircraft are shared across the service. Assuming an average fuel burn rate of 127.5 litres / hour this would represent 76,500 litres each year.

Using an emissions factor of 2.526 kg CO₂ per litre of burning oil⁷, the total fuel uses by aircraft in the estimated annual period shown above equates to annual total carbon dioxide emissions from the aircraft fleet of approximately 193 t CO₂.

3 Environmental Regulation and Standards

This section presents a review of international and national standards and legislation relevant to environmental aspects of ferries and aircraft operated by SIC. The key standards are listed and a short commentary then provided on their implications for the SIC fleet drawing on currently understood compliance with these standards and other relevant baseline information presented in Section 2. Where information is available on future regulation this has been included.

3.1 Ferries

3.1.1 Sulphur Oxide Emissions

Key Legislation & Requirements:

- European Directive 2012/33/EU on the sulphur content of marine fuels;
- MARPOL Annex VI, Regulation 14; and
- The Merchant Shipping (Prevention of Air Pollution from Ships) and Motor Fuel (Composition and Content) (Amendment) Regulations 2014.

Emissions from marine transport are subject to EU law and to standards set by the International Maritime Organisation (IMO). European Directive 2012/33/EU⁸ set new standards for levels of sulphur in fuels used by shipping in parts of the EU including the North Sea. The Directive incorporates limits set by Annex VI (Regulation 14) to the IMO's Marine Pollution Convention (MARPOL⁹).

⁷ Emission factor from DEFRA Emissions Conversion Factors for dataset year 2014.

<http://www.ukconversionfactorscarbonsmart.co.uk/> The DEFRA Methodology Paper which accompanies the emissions factor dataset identifies that the category of 'Burning oil' includes kerosene and aviation turbine fuel

⁸ Known as the Sulphur Content of Marine Fuels Directive

⁹ International Convention for the Prevention of Pollution from Ships

As of 1 January 2015, EU Member States have to ensure that ships in the Baltic, the North Sea and the English Channel (areas known as Sulphur Oxide Emission Control Areas (SECAs) which were originally established in Directive 1999/32/EC) are using fuels with a sulphur content of no more than 0.10% by weight. Higher fuel sulphur contents are still possible, but only if the appropriate exhaust cleaning systems are in place on the vessel. Shetland falls within the definition of the North Sea area¹⁰ which is set out in the Maritime and Coastguard Agency's (MCA) amended Merchant Shipping Notice MSN 1819¹¹.

The UK is a party to Annex VI of the MARPOL Convention and the EU Directive has been implemented into UK law by *The Merchant Shipping (Prevention of Air Pollution from Ships) and Motor Fuel (Composition and Content) (Amendment) Regulations 2014*. The Regulations apply to all consumers of marine fuel and no exemptions were allowed for when the legislation was introduced¹².

SIC ferries all operate on low sulphur gas oil and SIC has advised that no retrofit of the vessels' engines would be required. TMG have similarly confirmed that if a vessel's engines are already using MGO (MDA) or LSMGO then they can also use ULSMGO as well without any issues/machinery modifications. LNG is even cleaner, but would require extensive modifications to the engines if it was ever required.

Implications for SIC Ferries

It is understood that all SIC ferries currently operate using marine gas oil (MGO) and they are also capable of running with ultra-low sulphur marine gas oil (ULSMGO).

3.1.2 Other Air Pollutant Emissions

Key Legislation & Requirements:

- MARPOL Annex VI; and
- The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008.

MARPOL Annex VI includes regulations for the Prevention of Air Pollution from Ships which seeks to minimise airborne emissions from ships (SO_x, NO_x, and VOCs). Annex VI entered into force in May 2005 and a revised Annex VI with significantly tightened emissions limits was adopted in October 2008 which entered into force on 1 July 2010.

MARPOL Annex VI also prohibits deliberate emissions of ozone depleting substances, which include halons and chlorofluorocarbons (CFCs). New installations containing ozone-depleting substances are prohibited on all ships however new installations containing hydrochlorofluorocarbons (HCFCs) are permitted until 1 January 2020.

Annex VI sets limits on emissions of nitrogen oxides (NO_x) from diesel engines. A mandatory NO_x Technical Code, which defines how this shall be done, was adopted by the Conference under the cover of Resolution 2. The Annex also prohibits the incineration on-board ship of certain products, such as contaminated packaging materials and polychlorinated biphenyls (PCBs).

¹⁰ The area south of 62 degrees north latitude and east of 4 degrees west longitude

¹¹ Maritime and Coastguard Agency (MCA) (2013) Merchant Shipping Notice MSN 1819 (Amended) (M+F)

¹² Explanatory Memorandum to The Merchant Shipping (Prevention of Air Pollution from Ships) and Motor Fuel (Composition and Content) (Amendment) Regulations 2014 (2014 No. 3076)

The requirements of Annex VI were transposed into UK law through *The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008* and guidance on these was provided to the industry through the MCA's MSN 1819¹³.

The Regulations set out a series of requirements to prevent various emissions to air from ship engines and other activities on vessels and at ports. Most of the requirements relate to the design and manufacture of marine engines rather than to operational controls. Key points in summary are:

- controls on **ozone depleting substances**¹⁴ (ODS) relate to systems and installations, essentially prohibiting ODS in such systems since May 2005 but allowing for hydro-fluorocarbons (HFCs) to remain in use until 1 January 2020;
- various requirements are set out to control **nitrogen oxides** (NOx) on engines with a power output of 130kW or more and installed on ships since 1 January 2000;
- provision for the control of **Volatile Organic Compounds** (VOCs) from ships by harbour authorities and terminal operators who operate vapour emission control systems and who wish to control VOC emissions from ships in harbour. This generally applies to tankers;
- technical specifications (type approvals) to control emissions from any shipboard incinerators; and
- requirements relating to the quality and delivery of fuel oil to 'relevant ships'¹⁵ in harbour (bunkering) on both the Master and the fuel oil supplier including a bunker delivery note to confirm that the fuel oil is in conformity with relevant MARPOL Annex VI regulations (including a record of the fuel's sulphur content).

The Regulations also introduce a survey and certification requirement for new ships and subsequently every five years after initial certification to ensure that vessels are compliant with the Regulations¹⁶.

All SIC operated ferries are >130kW with the exception of the New Advance which is operated by a third party on behalf of SIC and has total power of 126kW.

There are no facilities in Shetland to recover VOCs outwith Sullom Voe terminal.

Implications for SIC Ferries

From the review undertaken there do not appear to be any specific requirements for pollution control which would require changes to the current SIC ferry fleet. Any new vessels would need to comply with the relevant legislation on NOx and ODS.

¹³ Maritime and Coastguard Agency (MCA) (2008) Merchant Shipping Notice MSN 1819 (M+F). This note was amended in 2013 to address the changes in sulphur fuel requirements brought about by the 2014 Regulations (see above) but remains applicable for other pollutants such as NOx and ozone depleting substances

¹⁴ ODS are defined in paragraph 4 of article 1 of the Montreal Protocol on Substances that Deplete the Ozone Layer (as amended)

¹⁵ Relevant ships are defined in the Regulations as platforms, or vessels in excess of 400 gross tonnes

¹⁶ Maritime and Coastguard Agency (MCA) (2008) Marine Guidance Note (MGN) 381, Survey and Certification Requirements for The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008

3.1.3 Future Air Pollution Legislation

The Explanatory Memorandum to *The Merchant Shipping (Prevention of Air Pollution from Ships) and Motor Fuel (Composition and Content) (Amendment) Regulations 2014* indicates that UK Government will undertake a further review in 2015/16 of the Regulations once the international community has finalised amendments to the regime relating to NOx.

The Explanatory Memorandum also notes that the impact of the policy will be kept under review and will be assessed in 2019 by the Maritime and Coastguard Agency (MCA) following a wider review of fuel availability being carried out by the International Maritime Organisation (IMO).

Further Regulations may be expected in the next 2-4 years therefore which could have implications for the specifications for marine fuel and/or for limits on emissions from ships.

3.1.4 Carbon Emissions

Key Legislation & Requirements:

- EU Regulation 2015/757 on the monitoring, reporting and verification (MRV) of carbon dioxide emissions from maritime transport;
- EU Directive 2009/16 on the monitoring, reporting and verification of carbon dioxide from marine transport; and
- MARPOL Annex VI Chapter 4.

At EU level the Regulation¹⁷ (EU) 2015/757 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, and amending Directive 2009/16/EC seeks to establish an EU system for monitoring, reporting and verifying (MRV) emissions from large ships using EU ports. The EU MRV Regulation will apply to shipping activities carried out from 1 January 2018 in relation to EU ports.

This requirement applies to ships in excess of 5,000 tonnes. None of the vessels in the SIC ferry fleet exceed this size therefore this MRV Regulation would not apply to Shetland.

IMO adopted mandatory technical and operational energy efficiency measures¹⁸ to reduce the amount of CO₂ emissions from international shipping. These are the Energy Efficiency Design Index (EEDI), which sets compulsory energy efficiency standards for new ships, and the Ship Energy Efficiency Management Plan (SEEMP), a management tool for ship owners (applying to all ships). These apply to all ships over 400t gross tonnage.

Four of the SIC ferry fleet (Dagalien, Daggri, Leirna & Linga) exceed 400 gross tonnes. The Dagalien, Daggri and Linga have voluntary¹⁹ SEEMPs in place to assist in managing CO₂ emissions. The Leirna is not a 'sea-going vessel' as it is certified for use only in Category D waters.

Implications for SIC Ferries

The EU mandatory carbon emissions reporting and verification system does not currently apply to inter-island ferry services in Shetland as none of the vessels in use exceeds the minimum threshold

¹⁷ EU Regulations apply directly to all Member States and do not require national legislation to implement them

¹⁸ Through MARPOL Annex VI, Chapter 4 (Regulations on energy efficiency for ships)

¹⁹ Domestic vessels are not required to have a SEEMP (see MGN 462 para 6)

size of 5,000 tonnes for this scheme.

The requirement for EEDIs and SEEMPs now applies to all vessels over 400 tonnes. In the SIC ferry fleet this would affect four vessels (the MV Daggalien, MV Daggri, MV Leirna and MC Linga) which are required to have a SEEMP to manage CO₂ emissions.

3.1.5 Waste Management & Marine Pollution – Ships and Ports

Key Legislation & Requirements:

- EU Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues (and Directive 2007/71/EC which amends Annex II of the 2000 Directive to include reference to sewage);
- The Merchant Shipping and Fishing Vessels (Port Waste Reception Facilities) Regulations 2003;
- The Merchant Shipping and Fishing Vessels (Port Waste Reception Facilities) (Amendment) Regulations 2009; and
- The Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008, as amended.

The Merchant Shipping and Fishing Vessels (Port Waste Reception Facilities) Regulations 2003 require ships to:

- provide notification before entry into port of the waste they will discharge, including information on types and quantities;
- deliver their waste to port reception facilities before leaving port, unless they have sufficient dedicated storage capacity for the waste and for it to be accumulated until the next port of call; and
- pay a mandatory charge to significantly contribute to the cost of port reception facilities for ship-generated waste, whether they use them or not.

The Regulations provide for exemption from the three key requirements of the legislation at one or more ports of call. Ships eligible for exemption must be engaged in “scheduled traffic with frequent and regular port calls”. SIC do not have an exemption for the ferry fleet.

The legislation also requires that Port Waste Management plans are required to be submitted and approved by the MCA. MGN 387 guidance identifies that in remote areas of the UK such as the smaller Scottish islands local factors would render the preparation of waste management plans in each port impractical and environmentally unsustainable. In these cases the guidance states that an option exists to implement regional waste management planning in the locality.

SIC operates its fleet under a Port Waste Management Plan (see <http://www.shetland.gov.uk/ports/contingencyplans/wastedisposal.asp>)

Sewage

Procedures for dealing with sewage containment, treatment and discharge from ships are addressed in the 2008 Regulations. Guidance²⁰ to the 2008 Regulations defines the types of on board sewage treatment facilities which are required to allow for discharge of sewage at sea.

²⁰ Maritime and Coastguard Agency (MCA) (2009) Marine Guidance Note MGN 385 (M+F)

The requirements on sewage relate to ships engaged in international voyages in excess of 400 gross tonnes and to ships of less than this size which are certified to carry more than 15 persons which are engaged on international voyages. Since the SIC ferry fleet is not engaged in international voyages it is assumed that the vessels are exempt from the provisions. The 2008 Regulations therefore do not apply however the Daggri, Dagalien and Linga have approved sewage plants on board so comply voluntarily. In the future there may be more stringent requirements to control the discharge of sewage from vessels by the Maritime and Coastguard Agency (MCA).

Garbage

The 2008 Regulations set out various requirements for management of waste on board ships. In summary these are:

- Garbage Management Plans (all ships over 400t gross weight and all ships certified to carry 15 or more persons);
- Garbage Record Books which applies to ships over 400 gross tonnage;
- general controls (all vessels) which prohibit discharge of wastes;
- all vessels of length 12m or more must display placards to notify crew and passengers of the relevant prohibitions on the disposal of garbage to sea.

Guidance to the Regulations notes that the MCA may waive the requirement for maintaining entries to a Garbage Record Book for ships engaged on voyages of one hour or less.

The SIC ferry fleet do not require Garbage Management Plans or Record Books. MGN 385 advises that:

- Garbage Record Books only apply if the vessel goes offshore and SIC ferries do not (except for non-commercial trips to dry-dock); and
- there is a need for placards – these are displayed on board each vessel. In addition, the Safety Management System manual has a blanket “no discharge of waste at sea” statement.

SIC Ferries operates under a ‘zero overboard garbage discharge policy’ which is an integral part of the Services Policy and Auditing Regime and therefore the service operates to a higher standard than required by MARPOL Annex V.

Implications for SIC Ferries

Waste

SIC currently complies with the Regulations and has a Port Waste Management Plan in place.

Sewage

Vessels in the SIC ferry fleet are exempt from the UK Regulations controlling the containment, treatment and discharge of sewage from ships. However in the future there may be more stringent requirements to control the discharge of sewage from vessels by the Maritime and Coastguard Agency (MCA).

Garbage

The fleet do not require Garbage Management Plans or Record Books because the fleet operates under a stringent ‘zero overboard garbage discharge policy’.

3.2 Aircraft

3.2.1 Current Emissions Legislation and Standards

No relevant legislation or standards have been identified relating to the control of local air pollutant emissions from aircraft or relating specifically to aviation fuel quality.

The Inter Island airport system does not use de-icing fluid or even salt on the runways. Direct Flight may use a backpack system of de-icing for flight surfaces such as aircraft wings and tailfins. However quantities of de-icing fluid used would be very small.

Aviation is part of the EU Emissions Trading System (ETS) established by EU Directive 2003/87/EC and has been amended several times including by Directive 2008/101/EC which amended the original Directive to include aviation. EC maintains a list of aircraft operators²¹ who are subject to the ETS and in Scotland the requirements of the ETS for relevant operators are administered by SEPA.

Annex I to the Directive sets out exceptions²² to inclusion of the sector in the ETS. Two of these exceptions are relevant to air services in Shetland:

- a de-minimis exemption for commercial operators with either fewer than 243 flights per period for three consecutive four-month periods or flights with total annual emissions lower than 10,000 tonnes CO₂ per year;
- flights by aircraft with a certified maximum take-off mass of less than 5,700kg.

Northpoint Aviation has advised that the number of sectors in a four month a sample period (May-August 2015) was 503 (could express this as 250 rotations). Some of these sectors are, however, only 5 or 10 minutes long. The aircraft are also below the weight threshold being 2,990kg. The legislation was not designed to cover operators such as Direct Flight.

The inter-island air service uses Britten Norman Islander aircraft which weigh significantly less than 5,700kg which forms the lower threshold for qualification for the ETS. The Shetland inter-island air services are therefore currently outwith the legal scope of the EU ETS.

Implications for SIC Aircraft

The review has not indicated that there are any specific regulations or controls affecting emissions to air of pollutants from aircraft or ground aviation activities for the SIC fleet.

The review has identified that the current SIC inter-island aircraft service is outwith the scope of relevant regulation of carbon emissions (the European Emissions Trading System or ETS) as the aircraft deployed are significantly smaller than those qualifying for the ETS.

3.2.2 Future Legislation

It seems likely that from 2016 the EC will remove the suspension of the ETS relating to flights outwith the EAA – but since the other exemptions (de minimus and aircraft weight)

²¹ On the UK list are Direct Aviation Mgt (State of Operator listed as UK) and DirectV Group (State of Operator listed as USA)

²² Also set out in Annex B to guidance published in Environment Agency, Natural Resources Wales, Northern Ireland Environment Agency & SEPA (2014) Guidance for Aircraft Operators Administered by the UK, How to Comply with the EU ETS for the period 2013 to 2016

came from the original Directive it is less likely that they would be amended once the 2013-2016 period ends.

Changes to the size of aircraft operating in Shetland in future may affect whether the ETS would apply to an operator providing these services.

3.3 Other Legislation

Any proposed new infrastructure would be required to be taken through relevant consents which would include compliance with the relevant Environmental Impact Assessment (EIA) Regulations and if required, for proposals which could have significant effects on Natura sites, under Regulation 48 of the Habitats Regulations (Conservation (Natural Habitats, &c.) Regulations 1994 as amended). The process is commonly referred to as Habitats Regulations Appraisal.



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