Greenhouse gas emissions from refrigerants – information for hotels

An Overview
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Know more. Do more.
Background
In order to assess the materiality of refrigeration gas in the calculation of greenhouse gas emissions a survey was conducted with a sample of EarthCheck Certification members. This was done in conjunction with the annual Greenhouse Gas Coefficients review which the Griffith Institute for Tourism (GIFT) carries out for EarthCheck.

What is the issue?
The leakage of refrigerant gas is a small but significant source of greenhouse gas emissions, because of the high Global Warming Potential (GWP) of most of these gases. Also refrigerant losses negatively affect the energy efficiency of a refrigeration or air conditioning system and therefore increase energy consumption.

In hotels, refrigerants are involved in a wide range of end-uses: refrigeration in kitchens and individual guest rooms, cold rooms, ice machines, chillers and unitary air conditioning systems, heat pumps, and refrigerated transport. Historically, cooling agents were CFCs and HCFCs, but these are being phased out under the Montreal Protocol due to their ozone-depleting nature. Most widely used refrigerants are now HFCs.

However, HFCs have considerable GWP, about 140 to 11,700 times that of carbon dioxide. For this reason HFCs were included in the Kyoto Protocol under the UNFCCC. Just recently Parties to the Montreal Protocol have paved the way for a 2016 amendment to phase down HFCs which will then have a significant effect on the refrigeration and air conditioning sector globally.

HFC emissions related to refrigeration and air conditioning sector are produced in the manufacturing process, as a result of leakage over the operational life of the equipment, and after disposal of the equipment. Hotels that report on their greenhouse gas impact need to include refrigerants as part of Scope 1 under the Greenhouse Gas Protocol. However, in many cases the contribution is not material (under 5 percent) and can be omitted.

Why do hotels need to know?
It is possible to estimate the greenhouse gas emissions based on the type of equipment in use, and on the amount of refrigerant purchased and used (e.g. refilled during maintenance) over a specific period.

The total amount of refrigerant (so-called charge) in equipment varies considerably. Domestic refrigeration, as for example found in guest rooms, may contain between 0.05 and 0.5 kg of refrigerant. Industrial refrigeration and chillers typically contain the largest volumes of HFC. Chillers, for example, can contain up to 2,000 kg of refrigerant.

The Annual leakage rate is another important factor that determines emissions. Leakages can be considerable, for example up to 10% in residential air conditioning or 35% in
commercial refrigeration. Leakage in the order of several percent of the initial charge can also occur during assembly or disassembly of equipment. Best practice maintenance programs reduce leakage. For more detailed technical information refer to the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories 2006.

Refrigerants commonly used in the hotel industry are:

- R11 with a GWP of 4000 (e.g. in chillers), as a CFC subject to global phase out
- R22 with a GWP of 1700 (e.g. split air conditioning), as an HCFC subject to global phase out
- R134a with a GWP of 1430 (e.g. in chillers, fridges)
- R404A with a GWP of 3922 (e.g. ice machine, commercial refrigeration or cold rooms)
- R407C with a GWP of 1600 (e.g. air conditioning)

The following example provides data for a hotel in a tropical environment (Table 1). The total amount of CO₂-equivalent emitted as a result of refrigerant emissions is 115 tonnes per year. It can be seen that the two chillers are most significant in terms of emissions from refrigerants, with most other equipment being negligible. The cooling substance R600a has no relevant GWP. For comparison, and based on energy-related emissions known for this hotel, the refrigerant emissions represent about 43 percent of Scope 1 emissions and 3 percent of ‘Scope 1 plus Scope 2’ emissions. Thus, the overall contribution for this particular case can be classified as non-material.

Table 2 Real data for one out of seven hotels studied to examine the relevance of refrigerants as part of overall GHG emissions.

<table>
<thead>
<tr>
<th>Refrigeration/ Air conditioning Equipment</th>
<th>Number of Units</th>
<th>Type of Refrigerant</th>
<th>GWP of Refrigerant</th>
<th>Refrigerant Charge (kilograms)</th>
<th>Annual Leakage Rate (%)</th>
<th>Operation Emissions (t of CO₂e/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiller I</td>
<td>1</td>
<td>R134a</td>
<td>1430</td>
<td>750</td>
<td>7%</td>
<td>75</td>
</tr>
<tr>
<td>Chiller II</td>
<td>1</td>
<td>R407C</td>
<td>1526</td>
<td>200</td>
<td>7%</td>
<td>21</td>
</tr>
<tr>
<td>Walk in chiller</td>
<td>7</td>
<td>R22/R404A</td>
<td>1700</td>
<td>13</td>
<td>7%</td>
<td>11</td>
</tr>
<tr>
<td>Walk in freezer</td>
<td>2</td>
<td>R22/R404A</td>
<td>1700</td>
<td>13</td>
<td>7%</td>
<td>3</td>
</tr>
<tr>
<td>Fridges/chillers</td>
<td>18</td>
<td>R134a</td>
<td>1430</td>
<td>1.5</td>
<td>7%</td>
<td>3</td>
</tr>
<tr>
<td>Fridges freezers</td>
<td>4</td>
<td>R22/R404A</td>
<td>1700</td>
<td>1.5</td>
<td>7%</td>
<td>1</td>
</tr>
<tr>
<td>Counter fridges</td>
<td>16</td>
<td>R22/R404A</td>
<td>1700</td>
<td>1.5</td>
<td>3%</td>
<td>1</td>
</tr>
<tr>
<td>Minibars in rooms</td>
<td>512</td>
<td>R600a</td>
<td>3</td>
<td>0.1</td>
<td>1%</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>115</td>
</tr>
</tbody>
</table>

Seven other hotels were examined as well and the contribution of refrigerants to total climate impact was in all cases under 3 percent. However, depending on equipment and usage a hotel may reach the materiality threshold of 5 percent.
Recommendations for hotel managers and engineers

- Establish and maintain records for large pieces of equipment, including information on the quantity and type of refrigerant installed and added during maintenance / servicing or due to leakage. This will make you aware of any refrigerant leaks and related costs.
- Smaller sources, for example plug-in equipment (e.g. minibars in guest rooms) are usually not significant and can be omitted in an inventory if time is a constraint.
- Have equipment regularly maintained by qualified persons, e.g. by establishing maintenance contracts that include regular preventative checks of refrigerant-relevant equipment. This will reduce your energy costs.
- For new buildings or installations check for availability of centralized systems running with halogen-free refrigerants rather than HFC systems. E.g. ammonia (NH₃) is increasingly used as a non-ozone depleting and non-global warming cooling agent and might be a suitable option meeting your demands. This will avoid greenhouse gas emissions and will give you a long-term sustainable solution.
- Energy consumption for refrigeration and air conditioning systems account for a significant share of your energy bill. Hence, efficient systems will save you money in the long run even if they involve higher first costs.

Further technical information:

http://eia-global.org/images/uploads/Putting_the_Freeze_on_HFCs_Final.pdf