



S. Neaman Institute Energy Forum
Energy Savings in Industrial Air Conditioning Systems
11 June 2007

Minimizing Greenhouse Gas Emissions from Air Conditioning Systems

Dr. Miriam Lev-On
California, USA



The LEVON Group, LLC
Environmental Consultancy & Facilitation



Overview

- ★ **Ozone Depleting Substances (ODS)**
- ★ **High Global Warming Potential Greenhouse Gases**
- ★ **European Policy and Regulation of Fluorinated Gases**
- ★ **U.S. Program on High GWP Gases**
- ★ **U.S. Emissions Trends**
- ★ **Relevance to Israel**
- ★ **Summary**





Substitution of Ozone Depleting Substances

- ✦ Under the terms of the **Montreal Protocol** many refrigerants are being phased out worldwide
- ✦ The compounds being replaced are used in a variety of industrial applications
 - ✦ For example, Air conditioning equipment and chillers
- ✦ Some of the fluorinated gases that are used as substitutes are also potent greenhouse gases
 - ✦ Contribute significantly to climate change due to their high global warming potential





Global Warming Potential (GWP) of Refrigerants

- ★ The GWP is the ratio of the warming caused by a substance to the warming caused by a similar mass of CO₂
- ★ If the GWP of CO₂ is defined to be 1.0:
 - ★ CFC-12 has a GWP of 8,500, and
 - ★ CFC-11 has a GWP of 5,000.
- ★ Different replacement refrigerants, known collectively as HCFCs and HFCs, have GWPs ranging from 93 to 12,100
- ★ **Leaking** or **Venting** of these compounds would have a large global warming impact





Impact of Air Conditioning Systems

- ★ The use of Heating, Ventilating and Air Conditioning (HVAC) systems is an essential element of contemporary life
- ★ HVAC Systems contribute to greenhouse gas releases in several ways:
 - ★ **Directly** through the effect of refrigerant losses
 - ★ **Indirectly** through energy consumption and related effects
- ★ Policy measures should include these aspects for HVAC systems





EU Regulation

[2003/0189A; 14 March 2006]

☀ **Article 3: Containment**

- Take all measures that are technically and economically feasible to prevent and minimize leakages

☀ **Article 4: Recovery**

- Fluorinated gases must be recovered for recycling, reclamation or destruction from the cooling circuits of all refrigeration, air-conditioning and heat pump equipment

☀ **Article 5: Training and Certification**

- Establish programs to train and certify personnel involved in inspecting for leaks and those involved in the recovery, recycling, reclamation and destruction of fluorinated gases

☀ **Article 6: Reporting**

- Report fluorinated gases produced, imported and exported in quantities above one tonne per year





EU Approach to Containment of Fluorinated Gases

★ Main requirements to attain containment

- ★ duty to prevent and minimize leakage
- ★ mandatory inspections for leakage
- ★ maintenance of records

★ Installation of leakage detection systems

- ★ All owners of stationary refrigeration, air-conditioning and heat-pump equipment and fire protection systems containing **300 kilograms or more of fluorinated gases**
- ★ Subject to on-site inspection by authorities

★ Maintain records

- ★ For all **systems ≥ 3 kilograms of fluorinated gases**
- ★ Include information on the quantity and type of fluorinated gas installed and on amounts added and recovered during servicing.





U.S. Program to Control High GWP Gases

- ✦ The U.S. Clean Air Act includes specific requirements for phasing out ODS in compliance with the Montreal Protocol
- ✦ New, high GWP refrigerants, are substituted for refrigeration, air-conditioning, and other applications
- ✦ U.S. EPA has created several Partnerships with Industry to develop improved operating practices that would minimize use and leakage of High GWP compounds
- ✦ The U.S. EPA reports all emissions to the UN as part of the annual national GHG inventory





U.S. Emissions of Fluorinated Gases from ODS Substitutes

(Million Tonnes CO₂-E)

Gas	2000	2001	2002	2003	2004
HFC-23	0.1	0.1	0.1	0.1	0.1
HFC-32	0.3	0.3	0.3	0.4	0.4
HFC-125	11.2	12.3	13.4	14.7	16.3
HFC-134a	45.4	49.7	53.5	56.8	61.6
HFC-143a	8.2	10.1	12.2	14.6	17.3
HFC-236fa	1.4	1.8	2.1	2.3	2.3
CF ₄	+	+	+	+	+
Others*	4.6	4.5	4.6	4.6	5.3
Total	67.2	78.6	86.2	93.5	103.3

+ Does not exceed 50,000 tonnes

* Other compounds used primarily for solvent applications





Technician Certification Requirements

- ★ The U.S. Federal Clean Air Act requires certification in proper refrigerant handling techniques
 - All persons who maintain, service, repair, or dispose of appliances that contain regulated refrigerants
- ★ Levels of technician certification include:
 - **TYPE I** - maintain, service or repair small appliances;
 - **TYPE II** - maintain, service, repair or dispose of high or very high-pressure appliances, except small appliances and motor vehicle air conditioning systems;
 - **TYPE III** - maintain, service, repair or dispose of low-pressure appliances;
 - **UNIVERSAL** - maintain, service or repair both low and high-pressure equipment, as well as small appliances.





Current Status in Israel

- ✦ Israel has ratified the two major treaties that deal with atmospheric protection:
 - ✦ The **Montreal Protocol** to limit production and commerce of Ozone Depleting Substances
 - ✦ The **Kyoto Protocol** to limit Greenhouse Gas emissions
- ✦ Under the **Montreal Protocol** Israel has specific deadlines for compliance
- ✦ Under the **Kyoto Protocol** Israel does not have mandatory compliance targets yet
 - ✦ It is expected that there will be new mandatory targets after 2012





Reduction of Imports of Ozone Depleting Substances into Israel

Year	% Reduction	Max Quantity
1989	Base Year	329
1996	Stabilization	329
2004	35%	213
2010	65%	115
2015	90%	33
2020	99.5%	1.645 (for existing installations)
2030	100%	0

Source: Israel Ministry of Environmental Protection, Feb. 2007





In Summary

Improving the efficiency of commercial and industrial air conditioning and refrigeration systems could lead to reduced power demand and increased operational efficiency

Strict Operating Procedures and Training are required for upgrading projects and refrigerant replacement

Ensure selection of appropriate refrigerants

Minimize the potential for venting and leakage

**More Information
levon@levongroup.net**

