ICTSD Programme on Trade and Environment

HS Codes and the Residential and Commercial Buildings Sector[1]

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[1] This paper builds on a 2008 mapping study commissioned by the International Centre for Trade and Sustainable Development ("ICTSD") and prepared by the Energy and Resources Institute (TERI) in India. The objective of the mapping study was to identify key climate-mitigation technologies and associated goods relevant to the residential and commercial buildings sector which was identified by the Intergovernmental Panel on Climate Change ("IPCC") as one of the critical sectors for mitigation of GHG emissions. The views expressed in this paper are those of the author and do not necessarily reflect the views of ICTSD or the funding institutions.

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1. Abbreviations and acronyms

UN	United Nations
WCO	World Customs Organization [i]
WTO	World Trade Organization

2. Harmonized System

2.1 Introduction

With a view to facilitating international trade, a commodity classification system was developed by the World Customs Organization (WCO). This system is laid down in the International Convention on the Harmonized Commodity Description and Coding System (done at Brussels, on 14 June 1983), also known as the “Harmonized System” or “HS”. As of 1 July 2009, 137 countries and economic or Customs unions are contracting party to this convention and another 70 countries and economic or Customs unions apply the system on a voluntary basis for Customs tariff and statistical purposes, thus covering over 98 percent of global trade.

Since the Harmonized System is updated on a more or less regular basis – sets of amendments came into force on 1 January 1992, 1996, 2002 and 2007, respectively – users may refer to different editions. Any reference in this paper to HS headings, subheadings and Section, Chapter or Subheading Notes, is based on the fourth edition (2007) of the Harmonized System.

2.2 Application

The Harmonized System is a multi-purpose tool, both in concept and design. Although developed as a Customs tariff and statistical tool, it is also used by governments, international organisations and the private sector for:

- internal taxes
- trade policies
- monitoring of controlled goods
- rules of origin
- freight tariffs
- transport statistics
- price monitoring
- quota controls
- compilation of national accounts
- economic research and analysis

The United Nations (UN) are using HS subheadings as building blocks for its economic classifications. Consequently, the data used for statistical systems such as the Standard International Trade Classification (SITC), the International Standard Industrial Classification of all economic activities (ISIC) and the Central Products Classification (CPC), is based on HS classification.

Also, the World Trade Organization (WTO) and its members use the Harmonized System as a common language for trade negotiations, and tariff concessions schedules of WTO members are based on the Harmonized System. In addition, the HS is also providing a basis for the Harmonization of non-preferential Rules of Origin, currently under development by the WTO.

Other international organisations use the HS as an instrument for monitoring international trade in certain controlled goods, e.g., chemical weapons material, hazardous waste, ozone-layer depleting substances and certain hazardous chemicals. The use of a single, global classification system in these areas has proved to be of great benefit to the implementation of and compliance with the international instruments involved.

Classification in the Harmonized System is also extensively used by individual countries in the application of preferential tariff treatment, in particular for the identification of the goods and for the determination of the origin of the goods.

2.3 Classification principles

The classification of goods in the Harmonized System follows its own rules. The appropriate HS heading or subheading for each commodity has to be determined on the basis of a full description of the goods, in association with the texts of the headings (and subheadings), any relevant Section, Chapter or Subheading Notes, and the General Interpretative Rules. The General Interpretative Rules lay down guiding principles for classification purposes, with a view to arriving at a uniform interpretation and application of the system. For legal purposes, the wording of the headings and any relative Section, Chapter or Subheading Notes, are decisive. Titles of Section or Chapters are for reference only and do not have legal status.

The WCO has published Explanatory Notes to the Harmonized System, which clarify the scope of the headings and subheadings. However, they do not have legal status and cannot change the scope of a heading or subheading.

2.4 Structure

In the Harmonized System, commodities can be grouped together in a "heading". Such headings are identified by a code consisting of four digits. The first two digits of this code indicate the Chapter wherein the heading appears, while the latter two indicate the position within that Chapter. The two groups of digits are separated by a period. For example, HS heading 84.19 belongs to Chapter 84 and is the 19th heading in that Chapter.

Most of the headings have been further subdivided into two or more one-dash subheadings which, where appropriate, have been further subdivided into two or more two-dash subheadings. Such subdivisions are identified by a unique six digits code, the so-called "HS code". The first four digits of this HS code correspond to the heading number (but without the period between the first two digits and the last two), whereas the fifth and sixth digits identify the one-dash and two-dash subheadings, respectively. To identify the subheadings, the numbers one to nine are used. If there are no such subheadings, a zero is used. Also, if a heading has not been further subdivided, the last two digits are "00". The last two digits are separated from the first four by a period.

3. Appendices A1 and A2

3.1 Scope

Appendices A1 and A2 refer to commodities (both consumer goods and intermediates) and to technologies. The HS codes assigned would be applicable when the goods are presented (and, therefore, to be classified) separately. If components which constitute, for example, together a complete power plant, are presented together, the resulting HS code(s) may be different, due to the classification rules.

3.2 Assignment of HS codes

HS codes have been assigned to each of the commodities to the extent possible. In many cases, in particular in Appendix A2, it was not possible to assign an HS code, due to the fact that the description of the commodity at issue was not sufficiently specific in terms of the HS. For example, the reference to "integrated façade daylighting" does not provide a description which can be used to identify the commodity in terms of the HS. In these cases, no HS codes have been mentioned in the Appendices.

3.3 Results

The components listed in Appendices A1 and A2 are classified under 49 different HS codes, divided over 27 headings (see columns (3) and (2), respectively, of the table below). The table also shows the number of "hits" for each of the HS codes (column (4)).

With respect to the number of "hits" the following should, however, be taken into consideration.

First, in several cases no HS codes have been assigned. As indicated above, this is due to the fact that the description provided is lacking information which is needed to allocate a single HS code.

Second, it appears that the majority of the commodities fall within the HS chapters covering mechanical appliances (Chapter 84) and electrical apparatus (Chapter 85).

Finally, a particular HS code may cover a range of products, including the product referred to in one of the Appendices. This results in a so-called “ex-out”, which is identified by using the prefix “ex” in front of the HS code. For example, HS code 8504.10 covers all types of ballasts for discharge lamps or tubes. In Appendix A1 reference is made to “solid state (electronic) ballasts”, which is a particular type of ballast. Since not all ballasts are included in the Appendix reference, the prefix “ex” is used in front of HS code 8504.10.

4. Additional lists

4.1 WTO list and extracted list

In columns (5) and (6) of the table below, reference is made to the “WTO 153-list” and the “43-list”, respectively (hereinafter “the lists”). Where there is an overlap between the current document and any reference from the two lists, this is marked with “x” in the appropriate column.

4.2 WTO list

The “WTO 153-list” refers to the list of commodities specified in the Annex to WTO document JOB(07)/54 of 27 April 2007. This document concerns a non-paper by Canada, the European Communities, Japan, Korea, New Zealand, Norway, the Separate Customs Territory of Taiwan, Penghu, Kinmen and Matsu, Switzerland and the United States of America, presented pursuant to the continued work under paragraph 31 (III) of the Doha Ministerial Declaration (reduction of Customs tariff rates for environmental goods). The Annex to this WTO document tables descriptions of commodities as a basis for negotiations within the context of environmental protection, including the following areas:

- air pollution control
- management of solid and hazardous waste and recycling systems
- clean up or remediation of soil and water
- renewable energy plant
- heat and energy management
- waste water management and potable water treatment
- environmentally preferable products, based on end use or disposal characteristics
- cleaner or more resource efficient technologies and products
- natural risk management
- natural resources protection
- noise and vibration abatement
- environmental monitoring, analysis and assessment equipment

4.3 Extracted list

The “43-list” concerns 43 products (derived from the WTO 153-list) that the World Bank identified as being relevant to climate mitigation and was proposed by the United States of America and the European Communities informally at the WTO December 2007. Therefore, an overlap between this document with this list is also an overlap with the WTO 153-list.

4.4 HS codes

It is to be noted that both lists are using HS codes from the HS 2002 edition, whereas this document uses HS codes from the 2007 edition. For this document there is only one difference between the HS 2007 codes in column (3) and those referred to in both lists. This concerns the reference to solar stoves, which are classified in HS 2007 subheading 7321.19 (HS 2002 : 7321.11).

4.5 Scope of descriptions

Appendices A1 and A2 refer to the consumer and intermediate products, while the lists also include complete installations and parts of components. This means that the overlap of HS codes covered in this document with those from the lists, is restricted. On the other hand, all environmental areas covered by the lists have been taken into account when comparing them with the HS codes in Appendices A1 and A2.

5. Table

(1)	HS heading (2)	HS 2007 Code (3)	Frequency (4)	WTO 153-list (5)	43-list (6)
1	39.09	3909.40	1		
2	39.11	Ex 3911.90	1		
3	39.12	Ex 3912.90	1		
4	39.16	Ex 3916.90	1		
5	39.20	Ex 3920.30	1		
6	39.21	Ex 3921.11	4		
7		Ex 3921.13	4		
8	39.26	Ex 3926.90	1		
9	40.02	Ex 4002.59	1		
10	54.05	Ex 5405.00	1		
11	68.06	Ex 6806.10	3		
12		Ex 6806.90	3		
13	70.08	7008.00	1		
14	70.19	Ex 7019.39	1		
15	73.04	7304.31	1	x	
16		7304.39	1	x	
17	73.21	Ex 7321.19	1	x	x
18		Ex 7321.89	1		
19	76.16	Ex 7616.99	2		
20	84.03	Ex 8403.10	3		
21	84.15	Ex 8415.10	2		
22		Ex 8415.81	2	x	x
23	84.18	Ex 8418.10	1		
24		Ex 8418.29	1		
25		Ex 8418.30	1		
26		Ex 8418.40	1		
27		Ex 8418.50	2		

(1)	HS heading (2)	HS 2007 Code (3)	Frequency (4)	WTO 153-list (5)	43-list (6)
28		8418.61	2	x	x
29	84.19	Ex 8419.19	1	x	x
30		8419.50	1	x	x
31		Ex 8419.89	1	x	x
32		Ex 8419.90	2	x	x
33	84.43	Ex 8443.31	1		
34		Ex 8443.32	1		
35		Ex 8443.39	1		
36	84.71	8471.30	1		
37		8471.41	1		
38		8471.49	1		
39		8471.50	1		
40		Ex 8471.70	1		
41	85.04	Ex 8504.10	1		
42	85.23	Ex 8523.40	2		
43	85.36	Ex 8536.50	1		
44	85.39	8539.21	1		
45		Ex 8539.22	1		
46		8539.31	1		
47		Ex 8539.32	2		
48	85.41	Ex 8541.40	2	x	x
49	90.32	9032.10	1	x	x

ANNEX I – Tables

Table A1: Climate Mitigation Goods Available on a Commercial Basis

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
	Thermal Envelope	In most of the developing countries of Asia and South East Asia like China, Hong Kong, Thailand and Singapore a large focus has been given on an energy efficient building envelope to achieve energy efficiency in residential and commercial buildings. Technology for efficient insulation, Solar radiation through windows are available in the developing countries of Asia and South East Asia. **Insulation** Insulation technology is commercially available in India at the moment. Under such a category – PUF insulation, extruded polystyrene insulation goods are commercially available. In insulation the following types are there –	The insulation materials reduce the heat flow from the outside to the inside of the building and vice-versa (depending on climate differences). This reduces the cooling or heating loads and helps in reducing energy consumption for cooling within the building. Efficient glazing reduces the lighting load by using passage of natural light within the building that reduces the energy consumption. Efficient double glazed glasses reflects the heat (UV radiation of the sun) which reduces the passage of heat to the inside of the building thereby reducing cooling load and energy consumption.	Europe, Japan, U.S.		

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		<u>Fibrous Insulation</u> The characteristics of this type of insulation are – • Comprises of Rock wool and Glass wool in the form of slabs and rolls of density 24 to 48 kg/m^3 and thickness ranging from 25 to 75 mm • High-density 96 & 144 kg/m^3 rigid slabs and boards are also available. The typical thermal conductivity is around 0.029 W/mk at 10 deg.C mean temp. It is also available as pipe sections in densities from 85 to 144 kg/m^3. Resin Bonded mineral wool confirms to BIS : 3958(Pt.5), ASTM C553, C612 Some of the characteristics of fibrous materials which are used for fibrous insulation are as follows – *<u>Resin Bonded Mineral wool (Rock wool and Glass wool)</u>* • Made from selected siliceous rock melted at 1600 deg C and spun into fibres of diameter 4-5 microns • Confirms to standards IS: 8183, BIS: 3958 (Pt.5), ASTM: C513, C612.			Of rock wool In slabs, sheets or rolls : Ex 6806.10 In other forms : Ex 6806.90	Heading 68.06 : **Slag wool, rock wool and similar mineral wools; exfoliated vermiculite, expanded clays, foamed slag and similar expanded mineral materials; mixtures and articles of heat-insulating, sound-insulating or sound-absorbing mineral**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
						materials, other than those of heading 68.11 or 68.12 or of Chapter 69. 6806.10 - Slag wool, rock wool and similar mineral wools (including intermixtures thereof), in bulk, sheets or rolls 6806.90 - Other Heading 70.19 : **Glass fibres (including glass wool) and articles thereof (for example, yarn, woven fabrics).** - Thin sheets (voiles), webs, mats, mattresses, boards and similar nonwoven products : 7019.39 - - Other
		Rigid materials The characteristics of this type of insulation are – • Plastic foam materials comprising of rigid polyurethane foam (PUF), polyisocyanurate foam (PIR), perlite • PUF confirms to BIS: 5608, ASTM : C 591 and available in densities of 30 kg/m^3 to as high as 300kg/m^3 for pipe supports. • PIR confirms to BIS: 5608 standards and			Of glass wool In slabs, sheets or rolls : Ex 7019.39	

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		used for insulation applications in ships and also on RCC roof as underdeck insulation Perlite has high thermal conductivity value and is a porous material and confirms to ASTM C610 Some of the rigid materials which are used for rigid material insulation are as follows – <u>*Phenolic Foam*</u> confirms to BIS : 13204 low thermal conductivity <u>*Polyisocyanurate foam*</u> low thermal conductivity, low smoke emission and low water absorption • confirms to IS:12436, BIS : 5608			In primary form (i.e., liquids and pastes, including dispersions (emulsions and suspensions) and solutions; or in blocks of irregular shape, lumps, powders (including moulding powders), granules, flakes and similar bulk forms) : 3909.40 In primary form (i.e., liquids and pastes, including dispersions (emulsions and suspensions) and solutions; or in blocks of irregular	Heading 39.09 : **Amino-resins, phenolic resins and polyurethanes, in primary forms.** 3909.40 - Phenolic resins Heading 39.11 : **Petroleum resins, coumarone-indene resins, polyterpenes, polysulphides, polysulphones and other products specified in Note 3 to this Chapter,**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
					shape, lumps, powders (including moulding powders), granules, flakes and similar bulk forms) : Ex 3911.90	**not elsewhere specified or included, in primary forms.** 3911.90 - Other
		<u>*Cellulose fibre*</u> • good thermal insulation material and sticks to any surface configuration such as domes, steel beams, concrete columns • good fire resistance property			In primary form (i.e., liquids and pastes, including dispersions (emulsions and suspensions) and solutions; or in blocks of irregular shape, lumps, powders (including moulding powders), granules, flakes and similar bulk forms) : Ex 3912.90	Heading 39.12 : **Cellulose and its chemical derivatives, not elsewhere specified or included, in primary forms.** 3912.90 - Other
					Monofilament : Ex 3916.90	Heading 39.16 : **Monofilament of which any cross-sectional dimension exceeds 1 mm, rods, sticks and profile shapes, whether or not surface-worked but not otherwise worked, of plastics.**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
						3916.90 - Of other plastics
					Monofilament : Ex 5405.00	Heading 54.05 : **Artificial monofilament of 67 decitex or more and of which no cross-sectional dimension exceeds 1 mm; strip and the like (for example, artificial straw) of artificial textile materials of an apparent width not exceeding 5 mm.**
		Other than this, preformed insulation material is used for insulation. Preformed insulation material could be divided further into Expanded Polystyrene slabs, Extruded Polystyrene slab, Polyurethane / Polyisocyanurate slabs, Perlite boards. The characteristics of these materials are given below – <u>*Expanded polystyrene (EPS)*</u> • Light weight cellular plastic foam material comprising of carbon and hydrogen and derived from petroleum products • Confirms to BIS : 4671			In the form of plates, sheets, film, foil and strip (other than those of Chapter 54) and of blocks of regular geometric shape, whether or not printed or	Heading 39.21 : **Other plates, sheets, film, foil and strip, of plastics.** - Cellular : 3921.11 - - Of polymers of styrene

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
					otherwise surface-worked, uncut or cut into rectangles (including squares) but not further worked (even if when so cut they become articles ready for use). Ex 3921.11	
		Extruded Polystyrene • Improved variety of Expanded Polystyrene material and consists of closely linked beads / globules to form rigid slabs and pipe sections to reduce air gap between the beads • Lesser amount of water absorption			In the form of plates, sheets, film, foil and strip (other than those of Chapter 54) and of blocks of regular geometric shape, whether or not printed or otherwise surface-worked, uncut or cut into rectangles (including squares) but not further worked (even if when so cut they become articles ready for use). Ex 3920.30	Heading 39.20 : **Other plates, sheets, film, foil and strip, of plastics, non-cellular and not reinforced, laminated, supported or similarly combined with other materials.** 3920.30 - Of polymers of styrene

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		Polyisocyanurate / Polyurethane foam slab • Consists of urethane foam insulation materials and has a low thermal conductivity, lesser smoke emission & water absorption properties • Product matches the IS:12436 & BIS 5608 standards *Perlite Boards* • organic rigid board insulation consisting of expanded volcanic glass, wood fibres bonded with asphaltic binders and light in weight, stable dimension and larger compressive strength.			In the form of plates, sheets, film, foil and strip (other than those of Chapter 54) and of blocks of regular geometric shape, whether or not printed or otherwise surface-worked, uncut or cut into rectangles (including squares) but not further worked (even if when so cut they become articles ready for use). Of polyurethanes : Ex 3921.13 Of polyisocyanurates : Ex 3921.19 In sheets : Ex 6806.10 In other forms : Ex 6806.90	Heading 39.21 : **Other plates, sheets, film, foil and strip, of plastics.** - Cellular : 3921.13 - - Of polyurethanes 3921.19 - - Of other plastics Heading 68.06 : **Slag wool, rock wool and similar mineral wools; exfoliated vermiculite, expanded clays, foamed slag and similar expanded**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		• low 'R' value, high 'K' value and a tendency to absorb moisture Other than this specific materials are used for duct insulation and the characteristics of such materials are as follows – • Resin Bonded Mineral wool in density 32-48 Kg/m^3 and thickness 25 & 50 mm.			In sheets : Ex 6806.10 In other forms : Ex 6806.90	**mineral materials; mixtures and articles of heat-insulating, sound-insulating or sound-absorbing mineral materials, other than those of heading 68.11 or 68.12 or of Chapter 69.** 6806.10 - Slag wool, rock wool and similar mineral wools (including intermixtures thereof), in bulk, sheets or rolls 6806.90 - Other Heading 68.06 : **Slag wool, rock wool and similar mineral wools; exfoliated vermiculite, expanded clays, foamed slag and similar expanded mineral materials; mixtures and articles of heat-insulating, sound-insulating or sound-absorbing mineral materials, other than**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
						those of heading 68.11 or 68.12 or of Chapter 69. 6806.10 - Slag wool, rock wool and similar mineral wools (including intermixtures thereof), in bulk, sheets or rolls 6806.90 - Other
		• Polyurethane Foam 36 + 2 Kg/m^3 and thickness 30 mm			In the form of plates, sheets, film, foil and strip (other than those of Chapter 54) and of blocks of regular geometric shape, whether or not printed or otherwise surface-worked, uncut or cut into rectangles (including squares) but not further worked (even if when so cut they become articles ready for use). Of polyurethanes : Ex 3921.13	Heading 39.21 : **Other plates, sheets, film, foil and strip, of plastics.** - Cellular : 3921.13 - - Of polyurethanes
		• Nitryl Rubber elastomeric close cell			Ex 4002.59	Heading 40.02 :

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		material of density 55-70 Kg/m^3 and thickness 13-90 mm				**Synthetic rubber and factice derived from oils, in primary forms or in plates, sheets or strip; mixtures of any product of heading 40.01 with any product of this heading, in primary forms or in plates, sheets or strip.** - Acrylonitrile-butadiene rubber (NBR) : 4002.59 - - Other
		The materials used for chilled water pipe insulation are as follows – • High density polyurethane foam pipe support of density 90 – 100 kg/m^3 • Thickness, insulation of 30 – 50 mm, length of 300 mm with metal fittings The characteristics of the material used for equipment insulation are – • Expanded Polystyrene slab 20-22 kg/m^3 and thickness 50-75 mm.			Ex 3926.90 In the form of plates, sheets, film, foil and strip (other than those of Chapter 54) and of blocks of regular geometric shape, whether or not	Heading 39.26 : **Other articles of plastics and articles of other materials of headings 39.01 to 39.14.** 3926.90 -Other Heading 39.21 : **Other plates, sheets, film, foil and strip, of plastics.** - Cellular : 3921.11 - - Of polymers of styrene

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
					printed or otherwise surface-worked, uncut or cut into rectangles (including squares) but not further worked (even if when so cut they become articles ready for use). Ex 3921.11	
		• Polyurethane Foam slab 36 + 2 kg/m^3 and thickness 50 mm.			In the form of plates, sheets, film, foil and strip (other than those of Chapter 54) and of blocks of regular geometric shape, whether or not printed or otherwise surface-worked, uncut or cut into rectangles (including squares) but not further worked (even if when so cut they become articles ready for use). Of polyurethanes :	Heading 39.21 : **Other plates, sheets, film, foil and strip, of plastics.** - Cellular : 3921.13 - - Of polyurethanes

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		• Insulation fixed with cold bitumen adhesive			Ex 3921.13 NOTE : Not clear whether the description refers to any material combined with bitumen adhesive or to the expanded polystyrene or polyurethane slabs indicated above only. The applicable HS-codes given below concern the latter group. In the form of plates, sheets, film, foil and strip (other than those of Chapter 54) and of blocks of regular geometric shape, whether or not printed or otherwise surface-worked, uncut or cut into rectangles (including squares) but not further	Heading 39.21 : **Other plates, sheets, film, foil and strip, of plastics.** - Cellular : 3921.11 - - Of polymers of styrene 3921.13 - - Of polyurethanes

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		• Vapour Barrier and Aluminium covering is used			worked (even if when so cut they become articles ready for use). <u>Of polystyrene :</u> Ex 3921.11 <u>Of polyurethane :</u> Ex 3921.13 <u>NOTE :</u> Not clear whether the description refers to any material combined with aluminium or to the expanded polystyrene or polyurethane slabs indicated above only. The applicable HS-codes given below concern the latter group. In the form of plates, sheets, film, foil and strip (other than those of Chapter 54) and of blocks of regular	Heading 39.21 : **Other plates, sheets, film, foil and strip, of plastics.** - Cellular : 3921.11 - - Of polymers of styrene 3921.13 - - Of polyurethanes

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
					geometric shape, whether or not printed or otherwise surface-worked, uncut or cut into rectangles (including squares) but not further worked (even if when so cut they become articles ready for use). <u>Of polystyrene :</u> Ex 3921.11 <u>Of polyurethane :</u> Ex 3921.13	
		Glazing Glazing technologies are also commercially available. Under glazing technologies, <u>double glazed low emissivity (e) glasses</u> are commercially available. <u>*Triple glazed glasses*</u> are also used in many windows in Europe. These glasses do not allow heat to pass and provide larger warmth by not allowing the escape of heat. The glasses are warm not only on the edges but		Europe, U.K.	7008.00	Heading 70.08 : **Multiple-walled insulating units of glass.**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		also on the entire glass surface that is glazed. In Europe, triple glazed units are available with a U value of .8w/ m2k for the combination of glass and frame. The values could be as low as .5w/m2k along with a krypton fill. Triple glazed glasses with argon gases and R- 3 value are available. Also triple glazed glasses with argon gas and R- 5 value is available. Multi chambered glasses with high values of R- 12.5 is also available.				
	Heating Systems	In heating systems radiant heaters of small capacity are commercially available.	Used in heating the room during winter. An indirect heating method is being used. Radiant heaters are generally mounted on ceilings. The heat rays from outside meet floors, walls and surfaces. The radiant heater uses this heat to warm up the air in the dwelling zone. Spreads more heat in all corners of a room with lesser energy consumption with a larger use of natural heat.	U.S., Canada, India	NOTE : It is assumed that the radiant heaters at issue refer to a radiant ceiling system (other than mechanical or electrical) which utilizes either hot or cold water in order to heat or cool spaces. These systems come in the form of linear panels, and are made from an extruded aluminium heating strip that provides heat transfer to	Heading 76.16 : **Other articles of aluminium.** - Other : 7616.99 - - Other

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
					which copper tubing is attached. Classification according to material which gives the whole its essential character : Ex 7616.99 Ex 8403.10	 Heading 84.03 : **Central heating boilers other than those of heading 84.02.** 8403.10 – Boilers
		Condensing Boilers • Condensing boilers could capture larger amount of usable heat from the fuel. The operating efficiency of a condensing boiler is increased by the use of dual heat exchangers. The heat exchangers ensure that maximum amount of heat is transferred from the burner. The exchanger also helps in reducing the heat losses in the form of gas. • Condensing boilers are of the following types – a) regular and b) combination. The regular condensing boilers warm up the water through the use of hot water cylinder. The combination condensing boilers do not use cylinders for warming water. • The new condensing boilers work with a seasonal efficiency of 88%. The condensing boilers use Natural Gas, LPG and Oil as fuel. These boilers have burner control devices. It also includes fans, motors, heaters				

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		and other electrical equipments. It generally excludes pumps that are used for water circulation outside the pump. The condensing boilers contain storage combination boilers. The storage combination boilers contain layers of insulation. • The material used to insulate the stored hot water are mineral wool, polyurethane foam and fibre glass. <u>*Heating Controls*</u> Consists of time programmer and room thermostat. It also often contains a cylindrical thermostat with thermostatic radiator valves.	The thermostat timer switches off the heat once the room temperature reaches at the desired level through heating in cold climate. In this way the timer saves the wasteful use of energy and thereby helps in lowering of energy consumption and carbon emissions.		9032.10	Heading 90.32 **Automatic regulating or controlling instruments and apparatus** 9032.10 Thermostats
	Cooling and cooling loads	In cooling and cooling loads the technological softwares that are commercially available are – VISDOE, HAP, TRNSYS. Most of these softwares are imported from U.S. and Europe.	Calculates optimum cooling loads, energy performance for buildings to reduce extra energy consumption of a building. This helps in enhancing energy efficiency of a building.	U.S., Europe	<u>NOTE :</u> Software as such is not classifiable in the Harmonized System. The applicable HS-code below refers to software presented on CD-ROM.	Heading 85.23 : **Discs, tapes, solid-state non-volatile storage devices, "smart cards" and other media for the recording of sound or of other phenomena, whether or not recorded, including**

Sector: Residential and Commercial Buildings	**Technology**	**Technology sub-category and Goods (With Technical Description)**	**Environmental Benefits**	**Country**	**HS-Code/ Ex-out**	**Observations**
					Ex 8523.40	**matrices and masters for the production of discs, but excluding products of chapter 37.** 8523.40 – Optical media
		Duct Sealing A well designed sealed duct system could improve energy efficiency of the buildings. Improved duct systems reduce the loss of the conditioned air within the rooms of the building. This could reduce the energy consumption.	Reduction in the energy consumption through minimization of the air loss could save energy and would help in reducing emissions.		NOTE : It is assumed that the product at issue concerns the following : plastic coated aluminium sheeting bladder, mastic tape, adhesive foam, plastic tube, plastic ring and release paper. Ex 7616.99	Heading 76.16 : **Other articles of aluminium.** - Other : 7616.99 - - Other
	Heating, ventilation and air conditioning (HVAC) systems	High performance chillers with /without variable frequency drives (VFD) are commercially available. These goods are being produced by companies like Trane, Carrier, Denham Bush, Clivet. Also variable refrigerant volume (VRV) and variable refrigerant flow (VRF) systems are commercially available at the moment in India.	Consumes lesser energy during its usage in the window and centralized AC system of a building. This increases the energy efficiency of a building.	U.S., Canada, Belgium, Denmark, Finland, France, Singapore, United Kingdom.	Window or wall type ('split-system') : Ex 8415.10 Other, incorporating a reversible heat pump : Ex 8415.81	Heading 84.15 : **Air conditioning machines, comprising a motor-driven fan and elements for changing the temperature and humidity, including those machines in which the humidity cannot be separately regulated.** 8415.10 - Window or wall types, self-contained or

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
						'split-system' - Other : 8415.81 - - Incorporating a refrigerating unit and a valve for reversal of the cooling/heat cycle (reversible heat pumps)
		Geothermal heat pumps	Many of these combined heat and power plant in district heating use wood, natural gas and waste and provide a clean source of heat and power. Recycling of the heat for warming up the water and supplying it to residential places through distribution networks optimizes the usage of energy and help in attaining energy efficiency.		Ex 8418.61	Heading 84.18 : **Refrigerators, freezers and other refrigerating or freezing equipment, electric or other; heat pumps other than air conditioning machines of heading 84.15.** - Other refrigerating or freezing equipment; heat pumps : 8418.61 - - Heat pumps, other than air conditioning machines of heading 84.15
		District Heating This is a clean, energy efficient heat generation process in a centralized location that is then distributed to the residential and commercial buildings of a particular area It is used for space and water heating in residential and commercial buildings • Generally a combined heat and			Since this appears to be a system, the components are to be classified separately, as follows : Boilers : 8403.10	Heading 84.03 : **Central heating boilers**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		power system is used for district heating. Such systems generate heat and power simultaneously and the heat from power generation is also used for space heating of residential and commercial buildings of a particular area. • In this system, the combined heat and power plant pumps heated water and supplies it to the consumers through the distribution network. The supplied hot water in the residential buildings is applied in the radiators and the water used for domestic purposes is heated. • The domestic hot water gets heated through heat exchanger. The heated supply water warms up the water which comes out of the tap. The water from the homes is supplied back to the central heating plant where it is heated up. So the water is circulated in this way through the distribution pipelines. • In some cases steam is used as a medium for heating up the water.			Heat exchangers : 8419.50 Pipes and tubes (of steel, seamless) :	**other than those of heading 84.02.** 8403.10 – Boilers Heading 84.19 : **Machinery, plant or laboratory equipment, whether or not electrically heated (excluding furnaces, ovens and other equipment of heading 85.14), for the treatment of materials by a process involving a change of temperature such as heating, cooking, roasting, distilling, rectifying, sterilising, pasteurising, steaming, drying, evaporating, vaporising, condensing or cooling, other than machinery or plant of a kind used for domestic purposes; instantaneous or storage water heaters, non-electric.** 8419.50 – Heat exchange units Heading 73.04 : **Tubes, pipes and hollow**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
					7304.31 7304.39	**profiles, seamless, of iron (other than cast iron) or steel.** - Other, of circular cross-section, of iron or non-alloy steel : 7304.31 - - Cold-drawn or cold-rolled (cold-reduced) 7304.39 - - Other
		Wood Pellet Burning Stoves: • These are used at homes for heating purposes. The stove pellets range between. 3 – 1 inch in length. They are made from compacted sawdust, bark, agricultural waste, biomass fuels like nutshells, corn kernels, and soybeans.	Wood Pellet Burning Stoves are considered to be carbon neutral (the biomass used for the stove consumes carbon during its lifetime and the same wood when used in the stove releases some carbon dioxide) and hence are considered to be not a net carbon emitter. In this way they contribute to reduction of enhancement in environmental emissions.		Ex 7321.89	Heading 73.21 : **Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel.** - Other appliances : 7321.89 - - Other, including appliances for solid fuel
		Micro Combined Heating and Power Systems: • This would use cogeneration technology in generating heat for residential usage. This technology has been applicable for industrial applications. But now it is being	The fuel used in micro combined heating and power systems are cleaner and thereby would reduce the level of energy consumption to generate heat. A reduction in energy consumption would		Ex 8403.10 (By application of Note 3 to Section XVI of the HS – classification of machines having two or more	Heading 84.03 : **Central heating boilers other than those of heading 84.02.** 8403.10 – Boilers

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		developed in a micro scale to generate heat for residential usage. • These systems are used in a large scale in Denmark in distributing heater water in residential complexes. • Also some of these are solar energy based hybrid systems of big capacity. Other than this, integrated heat pumps are also used for providing energy services. Combined heating and power systems are used in residential and commercial buildings of various climatic zones. • Technical Characteristics – Integrated heat pumps (Require installation in places within a temperature range of 40 degree f – 90 degree , could be a geothermal heater with efficiencies of 300% - 600% in the coldest of winter nights) Many of these are already available in Europe. But research is going on in developing systems which have a higher efficiency and are available at a lower cost.	reduce the level of carbon emissions. Also these systems optimize the usage of energy and hence leads to lower emissions through larger energy savings.		functions)	
		Passive Solar Heating and Cooling: • Solar Energy is used in heating up the buildings with the minimum usage of pumps, fans for distribution of heat. Walls, windows, roofs,	These technologies reduce the use of energy consumption for heating of rooms by using natural energy to a larger extent and hence saves energy consumption and leads to			This appears to be an application format, rather than the description of the components of a particular system. It is, therefore, not possible to

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		floors, landscapes are used in controlling the heat generated by solar radiation. Daylighting design is also used in optimizing the usage of natural daylight as a heating option reducing energy consumption and use of any mechanical equipment for heating. High efficiency windows, with an insulation level of R-2000 and air-tight construction are used for passive solar heating. Also a window with a 30 degree south orientation also helps in passive heating of buildings through the use of solar energy. Double and triple glazed glasses are used for solar space heating. Also frames, multiple glazing, low-e coatings, insulating glass spacers, inert gas fills, are also used for space heating purposes. Mass materials of heavy nature are also used in the walls for space heating. Some of the other things that are used for space heating are - quarry tile, floor stones in a mortar bed brick or double layers of gypsum board on walls. These helps in absorption of solar energy and subsequent radiation of the sun heat in the room in the absence of sun. • In passive cooling technique ventilators, shading, vegetation, special glazing of windows are used	reduction in carbon emissions.			assign one or more HS-codes to this category.

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		to a large extent to provide cooling within the buildings. External shading devices are used for reducing space heating within the buildings. Also external heating is reduced by using good insulators, good reflective materials in walls and roofs. Cross ventilation techniques and mechanisms are also used for passage of cool breeze at night. • Buildings use louvres and shutter systems to block the sunrays from entering the room during summer. It is also used to allow the sunrays to come into the rooms of the house during winter. • Large windows facing south and building materials having thermal mass of high density that could absorb and release the heat are used in buildings. • Windows play a major role in passive solar cooling by helping in natural ventilation. • Direct gain systems are used where the sun rays directly heats up the building. The heat is stored in the thermal mass and in the stone floor slabs. The south facing windows provide maximum amount of sun rays during the winter that is absorbed and used for space heating. Similarly the windows would allow				

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		least amount of sun rays to pass onto the room in summer. Heat is retained in summer by using internal wall, floor that would be made of concrete, stone or masonry that might be painted with flat and dark colour. • Sun spaces or solarium are also often used in buildings. In such a system, solar radiation warms up the sun space directly. This then warms up the living space.				
	Building energy management systems (BEMS)	Honeywell and Siemens systems are commercially available. TRNSYS software programs are already available for carrying out simulation of optimal loads of collectors, storage tank, heat exchangers. Some other software programmes which are commercially available are - Ecotect, Lumen designer, AGI 32, Transys, VisDOE, RET screen, Energy plus and Design builder.	Monitors the usage of energy in a building. This reduces the chance of energy consumption in a building over the optimum level.	Germany, United Kingdom, United States, Europe, Belgium	<u>NOTE :</u> Software as such is not classifiable in the Harmonized System. The applicable HS-code below refers to software presented on CD-ROM. Ex 8523.40	Heading 85.23 : **Discs, tapes, solid-state non-volatile storage devices, "smart cards" and other media for the recording of sound or of other phenomena, whether or not recorded, including matrices and masters for the production of discs, but excluding products of chapter 37.** 8523.40 – Optical media
		The softwares are used for quantification of comfort/ discomfort hours, daylight received inside the building, impacts of various shading strategies, sizing for various renewable energy technologies, etc.				
	Active	*<u>Photovoltaics:</u>*	Uses the solar radiation,	Germany,	PV modules :	Heading 85.41:

Sector: Residential and Commercial Buildings	**Technology**	**Technology sub-category and Goods (With Technical Description)**	**Environmental Benefits**	**Country**	**HS-Code/ Ex-out**	**Observations**
	collection and transformation of solar energy.	Currently, crystalline silicon solar cells and modules are commercially available in India. Solar Photovoltaic Systems with an installed capacity of 2.9 MW are commercially available at the moment and are installed in the field. Solar power plants are being put up on field sites. Solar power packs are commercially available and are being applied in telecommunication sector. Solar home lighting systems, solar lanterns, solar street lights are also commercially available.	energy which is stored in the solar cells. This energy is used to generate electricity, for cooking. Thus energy efficiency is attained by use of renewable energy.	Canada	Ex 8541.40	**Diodes, transistors and similar semiconductor devices; photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes; mounted piezo-electric crystals.** 8541.40 - Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes
		Solar Thermal Systems: Solar thermal systems are also being used in the Indian industrial sector within the temperature range of 100 – 250 degree Celcius. This temperature requirement is met through high – temperature pressured water and low pressure steam.				Not possible to assign an HS-code, since there is no description of a particular commodity. The expression 'solar thermal systems' could refer to a number of different system designs, including systems using mirrors.
		Solar Cookers: Other than this concentrating dish type solar cookers, indirect heating type solar cookers			Concentrating cookers, of iron or steel : Ex 7321.19	Heading 73.21 : **Stoves, ranges, grates, cookers (including those with subsidiary boilers**

Sector: Residential and Commercial Buildings	**Technology**	**Technology sub-category and Goods (With Technical Description)**	**Environmental Benefits**	**Country**	**HS-Code/ Ex-out**	**Observations**
		with or without heat storage, hybrid type solar cookers, box type solar cookers are also commercially available in India. Other than this concentrating cookers like the parabolic dish type cookers are also available. The parabolic dish type solar cooker has a concentrator. For high capacity community cooking Scheffler cooker is commercially available in India				**for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel.** - Cooking appliances and plate warmers : 7321.19 - - Other, including appliances for solid fuel
	Domestic hot water	*Flat plate collector and evacuated tube collector* for domestic hot water heating are being commercially available in India. Solar water heaters with 2000 sq. metre collector area are commercially available. Smaller systems are also present that could be applied in residential buildings. The collectors have coated metallic tube, plate arrangements called absorbers, top glass cover, housing with back and side insulation. Efficiency of flat plate collectors could be increased by evacuated tube collectors in which the absorber is placed in an evacuated cylindrical glass tube.	Collects and uses the solar energy to heat water. Reduces the load for water heating within the house.	Germany, U.S.	Flat plate collector (part of a system) Ex 8419.90 Evacuated tube collector (part of a system) Ex 8419.90 Complete system : Ex 8419.89	Heading 84.19: **Machinery, plant or laboratory equipment, whether or not electrically heated (excluding furnaces, ovens and other equipment of heading 85.14), for the treatment of materials by a process involving a change of temperature such as heating, cooking, roasting, distilling, rectifying, sterilising, pasteurising, steaming, drying, evaporating, vaporising, condensing or cooling, other than machinery or plant of a**

Sector: Residential and Commercial Buildings	**Technology**	**Technology sub-category and Goods (With Technical Description)**	**Environmental Benefits**	**Country**	**HS-Code/ Ex-out**	**Observations**
						kind used for domestic purposes; instantaneous or storage water heaters, non-electric. - Other machinery, plant and equipment : 8419.89 - - Other 8419.90 – Parts
	Day-lighting	*Glare control of windows and in developing light pipes* which would transmit the natural light into the buildings for day lighting.				This appears to be a particular construction of a building, rather than the description of a particular commodity.
	Household appliances, consumer electronics and office equipment	***Continuous control (On/Off) systems*** for dimming, day-linking are commercially available. Ballast type control systems for fluorescent lighting are also commercially available. Such control systems are either tubular or compact. Other than this compatible dimmers and sensors are also commercially available. Aluminium luvers embedded in glasses are also available commercially. Some of the lighting options are as follows -	Adjusts the lighting load within a building based on the availability of natural light. This thereby reduces the loading requirements for lighting within a building. LEDs, fluorescent lamps provide light for a longer time period reducing the energy consumption.	U.S., Germany, U.K., Japan	Dimmer switch : Ex 8536.50	Heading 85.36 : **Electrical apparatus for switching or protecting electrical circuits, or for making connections to or in electrical circuits (for example, switches, relays, fuses, surge suppressors, plugs, sockets, lamp-holders and other connectors, junction boxes), for a voltage not exceeding 1,000 volts; connectors for optical fibres, optical fibre bundles or cables.** 8536.50 – Other switches

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		Incandescent GLS Bulbs • Low luminous efficacy (12 to 14 lumens / watt) and short life (only 1000 burning hours) • Consists of a gas filled glass bulb with tungsten wire filament which glows when electrical current is passed through it			Ex 8539.22	Heading 85.39 : **Electric filament or discharge lamps, including sealed beam lamp units and ultra-violet or infra-red lamps; arc-lamps.** - Other filament lamps, excluding ultra-violet or infra-red lamps : 8539.22 - - Other, of a power not exceeding 200 W and for a voltage exceeding 100 V
		Tungsten Halogen Lamps • Tungsten filament lamps same as GLS but with Halogen gas which prevents the vaporised tungsten being deposited on the quartz glass. • The gaseous compound flows back to the filament prolonging the life of the lamp. • The halogen lamp provides more than double the luminous intensity than the incandescent lamp and lasts twice as long. • Compact and with a wide variety from narrow spotlight to wall washers			8539.21	Heading 85.39 : **Electric filament or discharge lamps, including sealed beam lamp units and ultra-violet or infra-red lamps; arc-lamps.** - Other filament lamps, excluding ultra-violet or infra-red lamps : 8539.21 - - Tungsten halogen
		CFL • Fluorescent tubes packaged in the compact form • Save up to 80% electricity for same light			8539.31	Heading 85.39 : **Electric filament or discharge lamps, including sealed beam**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		out put as the GLS bulb. For example a 20 W retrofit CFL, with integral electronic ballast, will replace a 100 W GLS bulb. o Because of very long life, (12,000 burning hours from reputed manufacturers) far fewer lamps are required to be manufactured and transported resulting in saving of raw materials, transport and energy. o Reduces fire risk				**lamp units and ultra-violet or infra-red lamps; arc-lamps.** - Discharge lamps, other than ultra-violet lamps : 8539.31 - - Fluorescent, hot cathode
		Linear Fluorescent Lamps • Low pressure mercury vapour lamps. When an electrical charge is passed through the mercury vapour in the glass tube, the UV radiation is converted into visible light by the phosphors coated inside the tube. • In India the 40 W, T-12, (38 mm dia.) tubes with electro-magnetic chokes are commercially available. However these became obsolete in the mid 1980s in other countries with switchover to T-8 , 36 W (28 mm dia.) tubes which in turn are being replaced by tri-phosphor T-5, 28 W (16 mm dia.) tubes with high P.F. • Has an electronic ballast saving great deal of power usage • The efficacy of T-12 is approximately 60 lumens per watt against approximately 100 W for the T-5 lamp. • The switchover from T-12 lamp to T-5			Ex 8539.32	Heading 85.39 : **Electric filament or discharge lamps, including sealed beam lamp units and ultra-violet or infra-red lamps; arc-lamps.** - Discharge lamps, other than ultra-violet lamps : 8539.32 - - Mercury or sodium vapour lamps; metal halide lamps

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		lamp will save on average 30 W per lamp. • Approximately 240 Million T-12 lamp points are there in India. If 25 % are replaced by T-5 lamps with electronic ballasts it will lead to a savings of - 1. 2400 MW of Generating capacity 2. Saving 3285 KWH p.a. for consumers saving the consumers Rs 986 Crores p.a. in electricity charges. 3. 2.4 Million tons of coal p.a. the burning of which causes Greenhouse gases. • The life of T-5 lamp is > 20,000 hours against only 5,000 hours for T-12 • The electronic ballast automatically switches off in case of a failed lamp or defective lamp and eliminates the fire risk • The ECG operates at very high frequency (25 – 40 KHz) to ensure smooth flicker free light without stroboscopic effect responsible for eyestrains and headaches associated with the T-12 installations with conventional choke. • The electronic ballast operates on a wide range of 145 Volts to 285 volts and are ideal for the Indian conditions of wide voltage fluctuations				
		Super HPS lamps			Ex 8539.32	Heading 85.39 :

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		• Has an efficacy of 150 lumens / W • Allows higher mounting height for street lighting thereby reducing the no. of street light poles / KM with better illumination and uniformity. Leads to savings in new installations with respect to Energy, Capital cost and the running costs can be up to 25 %. • Long life and high luminous efficacy make the super lamps highly energy efficient and most economical				**Electric filament or discharge lamps, including sealed beam lamp units and ultra-violet or infra-red lamps; arc-lamps.** - Discharge lamps, other than ultra-violet lamps : 8539.32 - - Mercury or sodium vapour lamps; metal halide lamps
		Light Emitting Diodes • LED consists of several layers of semi-conductor material. • Forward biased light is generated in the thin layer. • Unlike the incandescent lamp radiating a continuous spectrum of light, an LED emits monochromatic light of a particular colour depending on the material used. • Efficacy of LED has already reached more than 30 lumens/ watt against a target of more than 50 lumens/ watt. • Typical size of an LED is a few hundred micrometers mounted in a package for easy electrical contact. • High shock resistance • Extremely long life, up to 100,000 burning hours. • The more immediate applications include, Instrument panels, Signage, Traffic and			Ex 8541.40	Heading 85.41 : **Diodes, transistors and similar semiconductor devices; photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes; mounted piezo-electric crystals.** 8541.40 - Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light emitting diodes

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		Railway signals, Rear and internal lights for cars, Back light for liquid crystal displays, Edge and path lighting, Garden lights with Solar voltaic energy source • No IR and UV radiation.				
		Solid State (Electronic) Ballasts • Energy efficient and have power loss of around 2 Watts against approximately 15 Watts for the existing copper/aluminium chokes which are being used in India with T-12, 40 Watt Tubes • Automatic shutdown in case of end of life or defective lamp, therefore, virtually eliminating fire hazard • High frequency operation (25 – 40 KHz) ensuring flicker-free light without stroboscopic effect • Increases lamp life by 50 % • Operates on wide voltage range of 145V to 285V • High power factor > 0.95 • Harmonics within IEC recommendations.			Ex 8504.10	Heading 85.04: **Electrical transformers, static converters (for example, rectifiers) and inductors.** 8504.10 – Ballasts for discharge lamps or tubes
	Consumer Electronics	*Energy efficient computers, disk drives and copiers* • Lesser consumption of energy by the processors • Energy efficient chips • Energy consumption in processor, input devices are reduced • Energy consumption in communication			NOTE : As the description is not very specific, HS-codes have been assigned for the following commodities only : Automatic data	Heading 84.43 : **Printing machinery used for printing by means of plates, cylinders and other printing components of heading 84.42; other printers, copying machines and**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		peripherals (networks, modems) are reduced • Timers exist to switch to lower power mode • Power management to recognize the resumption of activity			processing (adp) machines (computers), disk drives and copiers. <u>Copiers :</u> Ex 8443.31 Ex 8443.32 Ex 8443.39 <u>Adp machines :</u> 8471.30 8471.41 8471.49 8471.50 <u>Disk drives :</u> Ex 8471.70	**facsimile machines, whether or not combined; parts and accessories thereof.** - Other printers, copying machines and facsimile machines, whether or not combined : 8443.31 - - Machines which perform two or more of the functions of printing, copying or facsimile transmission, capable of connecting to an automatic data processing machine or to a network 8443.32 - - Other, capable of connecting to an automatic data processing machine or to a network 8443.39 - - Other Heading 84.71 : **Automatic data processing machines and units thereof; magnetic or optical readers, machines for transcribing data onto data media in coded form and machines for processing such data,**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
						not elsewhere specified or included. 8471.30 - Portable automatic data processing machines, weighing not more than 10 kg, consisting of at least a central processing unit, a keyboard and a display - Other automatic data processing machines : 8471.41 - - Comprising in the same housing at least a central processing unit and an input and output unit, whether or not combined 8471.49 - - Other, presented in the form of systems 8471.50 - Processing units other than those of subheading 8471.41 or 8471.49, whether or not containing in the same housing one or two of the following types of unit : storage units, input units, output units 8471.70 - Storage units
	Refrigeration systems	*Walking Coolers, Deep Freezers which are energy efficient* to certain extent are available	Consumes lesser amount of energy for cooling and freezer	Germany, U.S., U.K.	Ex 8418.50	Heading 84.18: **Refrigerators, freezers**

Sector: Residential and Commercial Buildings	Technology	Technology sub-category and Goods (With Technical Description)	Environmental Benefits	Country	HS-Code/ Ex-out	Observations
		commercially at the moment. 11 kw motors with an efficiency of 86% at given load with a power factor of 88% are used in the refrigeration systems. Uses cooling tower fan motors, secondary chilled water pumps, dry bulb economizer, and enthalpy control measures. Some of the fan systems which are available at the moment in the refrigeration and air – conditioning systems enhancing energy efficiency are – a) Forward – curved fan systems, b) Fans with vortex vanes. Dual Duct Constant Volume Systems, Low Leakage Dampers are also existent in some of them. Some of the refrigeration and ac systems use a) Screw chillers, b) Condensor pumps, c) Microprocessors on cooling tower fans. Trombe walls (half trombe, unvented trombe, vented trombe) are also being used for passive heating in certain refrigeration and air conditioning system.	systems. This increases the energy efficiency of the equipments.			**and other refrigerating or freezing equipment, electric or other; heat pumps other than air conditioning machines of heading 84.15.** 8418.50 - - Other furniture (chests, cabinets, display counters, show-cases and the like) for storage and display, incorporating refrigerating or freezing equipment

Source – Compiled from TERI Studies, TERI Analysis 2008[2]

Table A2: Climate Mitigation Goods Undergoing R&D

[2] Discussion with technology experts - Mr. Pradeep Kumar, Ms. Mili Majumdar, Dr. Pradeep Dadhich, Ms. Parimita Mohanty have also been useful in this compilation

Sector: Residential and Commercial Buildings	**Technology**	**Technology sub-category and Goods (With Technical Description)**	**Environmental Benefits**	**Country**	**HS-Code/ Ex-out**	**Observations**
	Thermal Envelope	*Integrated façade day lighting, electrochromic windows for improvement of day lighting and in development of sensors, analysis tools*. Technical Features – • *Integrated façade day lighting (Double Skin Facades, Dependent on Sun Shading which is located between exterior and interior glass façade, solar radiation is blocked before entering the building, absorbed heat by the pane shading system is released in the intermediate space)* • *Electrochromic windows (Low cost fabricating bleaches, upscaled sizes more than 14 by 16 inches for windows divided into small panes*) • *Sensors (Development of photosensors, Presence of timer switches, motion sensors)*	Insulation would allow efficient transfer of heat from outside to within the buildings and would reduce the cooling loads and would reduce power consumption. Sensors would lead to optimum use of light and would reduce additional energy consumption.	U.S., India, Japan, China, Australia, Hong Kong, Singapore, Thailand, Canada, Brazil		
		R& D is going on *thermally broken insulation technology*. **Technical Features –** • *thermally broken insulation technology (Uses hollow metal frames, Steel Doors insulated with fibreglass batting)* Developing next generation insulation				

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		technologies. In U.S., *insulation technologies are being developed which allows air transfer but does not allow transfer of moisture*. **Technical Features of the DU Pont Insulation Technology is –** • Helps in holding out of bulk water with vapour permeability preventing moisture accumulation in walls • The products are of the following types –				

		• Commercial Wrap (1000 sq. ft area), Stucco Wrap (1000 sq. ft area)
		• Installation accessories are – Wrap Caps (1000 caps/ box)
		• The materials used in designing the DU Pont Insulation technologies are –
		  • Air penetration matches ASTM E 1677, water vapour transmission matches ASTM E 96, water penetration matches AATCC 9 (American Association of Textile Chemists and Colorists) Test Method 127, Weight of the material matches the TAPPI Test Method T – 410
		  • Air filtration matches the TAPPI Test Method T – 460
		  • Tensile Strength matches ASTM D822				

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		In *improvement of thermal performance*. Specifically R&D is being carried out to develop – *a) conduction through opaque walls and window glass and b) solar radiation through window glass*.				
		Technical Features – • Opaque Walls (High value of overall thermal transfer value, high energy efficiency of the opaque walls) Developing insulation in the buildings and to reduce leakage by *developing optimum window areas, floor areas and occupancy spaces to incorporate energy efficiency in buildings*. Development of *specific window types for enhancing energy efficiency through larger ventilation*. In glazing, triple *glazed low e- krypton glasses with plastic at the centre* layer has been the focus area. **Technical Features –** • *triple glazed low e- krypton/argon glasses with plastic at the centre (parallely spaced glazing sheets separated by resilient spacing and sealing assembly, inner space comprises of moisture permeable foam material, separated glazing sheets creating insulated air space*				

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		which is filled with krypton gas)				
		Developing *low energy integrated building façade system*. This would have dimming ballast, optimal space conditioning provisions. Development of *exterior insulation systems, next generation roof and attic system, phase change insulation, better quality foams and dynamic membranes*. **Technical Features –** • *exterior insulation systems (Improvement in the interface detailing for improving the penetration property of exterior wall, improvement in the water penetration resistance of exterior wall for better insulation)* • *Phase Change Insulation (development of phase change materials smoothing out daily room temperature fluctuation, low cost material which is not toxic, corrosive or hydroscopic, melting temperature is above 25 degree Celsius)*				
		Technical Features of dynamic membranes – • ***Higher durability and better tear resistance property with an UV***				

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		resistance of 9 months. Have flexible membranes which could be easily installed in different wall assemblies. • ***Helps in reduction of air leakage protecting the R value of insulation thereby generating greater energy savings*** **Reinforced Concrete System** Technical Characteristics are – • ***reinforced concrete chimney shell placed over a reinforced concrete foundation*** • ***Structural steel access platforms giving support, lateral restraint*** • ***Reinforced concrete roof slab over structural steel beams*** • ***Insulated stainless steel being used as an input*** • ***Roof drainage system*** • ***and miscellaneous ferrous components*** • ***painting/coating of all structural steel work*** • ***Interior socket outlets***				
	Heating Systems	*R&D is ongoing in the existing heat and cold storage systems in Europe. In these*	Reduces the energy consumption due to higher efficiency and leads to a fall in fossil fuel	U.S., China, Europe		

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		technological systems, heat is captured by pumps for cooling in summer and the heat is stored in the underground and then the stored heat is applied in winter to warm up the temperature of the building. R&D is ongoing in enhancing the efficiency of these systems at a lower cost. R&D is ongoing to create chemical storage of heating in a little space of 1-3 cubic meters. The stored heat during summer generated through some mechanical and chemical solar thermal utilization subsystem and a PV (photovoltaic) subsystem Technical Characteristics – • *Centralized on medium and low temperature applications* • *Comprises of plates and photovoltaic cells for tapping solar energy* • *Comprises of a PV array and battery subsystem* • *Comprises of solar collector, the storage tank, and the heat exchanger*	consumption.			
	Cooling and cooling loads	*Fluorescent Refrigerant Leak Detection System* to optimize cooling loads. Technical Characteristics – *Fluorescent Refrigerant Leak Detection System(Uses ultraviolet blue light inspection lamps, fluorescent dyes which are infused into the air conditioning and refrigeration system)*	Increases the optimum utilization of energy for cooling. Increases the energy efficiency and reduces energy losses. This optimizes energy and fossil fuel consumption. Fluorescent dyes which are used in refrigeration system reduce the CFC emissions and contributes to	U.S., Canada		

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			environmental benefits.			
	Heating, ventilation and air conditioning (HVAC) systems	*Mean radiant temperature based systems, under floor radiant cooling/heating, refrigeration cycle. Development of helix condensor for HVAC systems*. Improved airflow and air handling systems. Development of *ventilation models, evaporative cooling and chilled beams for residential and commercial buildings* across various climatic zones. Technical Characteristics – *helix condensor (high efficiency evaporative condensor, thin walled helical coils, minimization of air water droplet contact with the helical coils)* *Solar powered absorption air conditioning systems* Technical Characteristics – • absorption chiller uses water and lithium bromide solution Developing *solar air conditioners* in Abu Dhabi as a part of the Masdar initiative.	Optimizes energy usage for air conditioning, heating and refrigeration. Reduces energy consumption for heating and cooling purposes which results in lesser fossil fuel consumption.	U.S., Canada, Europe, Australia	Window or wall type ('split-system') : Ex 8415.10 Other, incorporating a reversible heat pump : Ex 8415.81	Heading 84.15 : **Air conditioning machines, comprising a motor-driven fan and elements for changing the temperature and humidity, including those machines in which the humidity cannot be separately regulated.** 8415.10 - Window or wall types, self-contained or 'split-system' - Other : 8415.81 - - Incorporating a refrigerating unit and a valve for reversal of the cooling/heat cycle (reversible heat pumps)
		Reduction of energy requirement for refrigerants through the *use of monobloc systems to efficiently transfer energy to the point of requirement*. Recovery of *waste heat from refrigeration system for its usage in heating up the building and for recovery of hot water*.		Canada		

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		Technical Characteristics – Monobloc Systems (Rust free, moulded, quick removal of condensate waters, larger utilization of vibration isolators)				
		In developed countries reduction in the use of synthetic refrigerant by developing secondary loop refrigerant systems that would be integrated with the HVAC system of the buildings and would help in improving energy efficiency of buildings.		Canada, Hong Kong, Brazil	8418.61	Heading 84.18: **Refrigerators, freezers and other refrigerating or freezing equipment, electric or other; heat pumps other than air conditioning machines of heading 84.15.** - Other refrigerating or freezing equipment; het pumps : 8418.61 - - Heat pumps other than air conditioning machines of heading 84.15
		In air-conditioning R&D is being carried out in Hong Kong to develop more energy efficient air conditioners, refrigerators, freezers, air conditioners, incorporating modern ventilation techniques in the residential and commercial buildings. Also for improving indoor air quality of buildings through ventilation techniques and towards creating clean air conditioning techniques within residential and commercial buildings. Using natural ventilation techniques for				

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		improving energy efficiency of residential and commercial buildings. R&D is also being carried on desiccant cooling systems with larger life time, lower maintenance cost. Technical Characteristics – Natural Ventilation (ventilation opening could be small with a floor area between 10% - 15%, medium with a floor area between 15% - 25%, large with an area over 40%)				
	Building energy management systems (BEMS)	*Hybrid ventilation, task ventilation, and demand control ventilation* to build in energy management systems. Technical Characteristics – *Hybrid ventilation (Chemical Dehumidification, Insertion of solid desiccants in rotary heat exchanger)* *Advanced controls, wireless controls, integrated commissioning and diagnostics, information and monitoring diagnostics system, whole building diagnostician software*, internal commissioning. Technical Characteristics – Developing tools *like RESFEN and COMFEN, new softwares for creating new types of building geometry*. Development of building *information management, building energy usage analysis through out the life*	Optimizes the energy loads for ventilation and increases the efficiency of energy consumption. The optimal level of energy usage is managed through monitoring and review by a software system. This optimizes the use of fossil fuel consumption.	U.S., Europe		

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		cycle of the building. Technical Characteristics – *RESFEN and COMFEN, new softwares (new geometry simplification tool based on input from model based CAD, comprises of IDF generator)*				
	Active collection and transformation of solar energy.	Focusing on specific applications for development of solar PVs Technical Characteristics – • Development of crystalline silicon thin film layers and low cost substrates for deposition of films • Large size solar cells/ modules based on crystalline silicon thin films • Large size solar cells/ modules based on crystalline silicon thin films. • Polycrystalline thin film solar cells/modules • PV module technology with higher packing density and suitability for solar roofs. • Lightweight modules for use in solar lanterns and similar applications • Lightweight modules for use in solar lanterns and similar applications	Uses renewable sources of energy like the solar energy for meeting the energy needs and leads to reduction in fossil fuel consumption. This gives rise to environmental benefits.	Germany		
		Solar refrigeration Technical Characteristics –			Combined refrigerator-freezers, fitted	Heading 84.18 : **Refrigerators, freezers and other refrigerating**

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		• Absorption refrigeration system based on solar energy for ice plants • Usage of solar energy to remove volatile component from solution and create pressure • Silica gel used as adsorbent • Usage of waste heat and generation of hotware/ steam • Stainless Steel and Mild Steel Sheets of different thickness are being used • Solar panel efficiency of 8% - 10%			with separate external doors : Ex 8418.10 Refrigerators, household type : Ex 8418.29 Freezers of the chest type, not exceeding 800 l capacity : Ex 8418.30 Freezers of the upright type, not exceeding 900 l capacity : Ex 8418.40 Other furniture (chests, cabinets, display counters, show-cases and the like) for storage and display, incorporating	**or freezing equipment, electric or other; heat pumps other than air conditioning machines of heading 84.15.** 8418.10 - Combined refrigerator-freezers, fitted with separate external doors - Refrigerators, household type : 8418.29 - - Other 8418.30 - Freezers of the chest type, not exceeding 800 l capacity 8418.40 - Freezers of the upright type, not exceeding 900 l capacity 8418.50 - Other furniture (chests, cabinets, display counters, show-cases and the like) for storage and display, incorporating refrigerating or freezing equipment

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					refrigerating or freezing equipment : Ex 8418.50	
	Domestic hot water	Integrated solar thermal system for preparing domestic hot water. Low temperature solar thermal systems for integrating it into building system. • Technical Characteristics *Solar Collectors* Consists of stainless steel tank, combustion chamber which is cupronickel Heat exchanger coil to transfer solar energy to the water Secondary condensing tubing Blower gas valve that controls the air intake and exhaust Stainless Burner Condensate Line Cost effective solar water hydronic systems Low cost efficient heat pipe evacuated solar hot water collectors, u pipe evacuated solar hot water collectors, thermosyphon evacuated solar hot water collectors	Uses renewable source of energy for heating purposes. This reduces the fossil fuel consumption and leads to environmental benefits.	U.S., Europe, India, China	Ex 8419.19	Heading 84.19 : **Machinery, plant or laboratory equipment, whether or not electrically heated (excluding furnaces, ovens and other equipment of heading 85.14), for the treatment of materials by a process involving a change of temperature such as heating, cooking, roasting, distilling, rectifying, sterilising, pasteurising, steaming, drying, evaporating, vaporising, condensing or cooling, other than machinery or plant of a kind used for domestic purposes; instantaneous or storage water heaters, non-electric.** - Instantaneous or storage water heaters, non-electric :

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		Cost effective borosilicate glass, glazing by iron tempered glass, silicon cells Building integrated solar louvre collector system for solar thermal systems R&D is ongoing on increasing efficiency of receiver components of parabolic trough technology at higher temperature R&D is ongoing on heat transfer medium (like water, oil, ionic fluids) of solar thermal systems R&D is going on with respect to heliostats R&D is ongoing for advanced solar collectors with larger efficiency close to 70%, large solar dishes R&D is ongoing in reducing the heat loss coefficient of flat plate collectors				8419.19 – Other
	Day lighting	Advanced wireless lighting control systems, development of softwares to optimize the use of day lighting in commercial and residential buildings. Improvement of the energy efficiency of the CFl. <u>Technical Characteristics –</u> Light Pipes for natural light transmission (Directs daylight illuminance levels at 4.6 – 9.1 m from the window aperture with minimum solar heat	Optimizes the use of natural daylight for day lighting and hence reduces the energy consumption for day lighting. Reduction in energy consumption leads to environmental benefits.	U.S., Brazil		

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		gains. Computer assistance for sun ray tracing) Cheaper low emissivity glazing <u>Technical Characteristics –</u> • <u>Emissivity levels are low</u> • <u>Lesser allowance of the infra red portion of sunlight</u>				

Source – Compiled from TERI Studies, TERI Analysis 2008[3], websites mentioned in the references of the report

[3] Discussion with technology experts - Mr. Pradeep Kumar, Ms. Mili Majumdar, Ms. Priyanka Kochhar, Dr. Pradeep Dadhich, Ms. Parimita Mohanty have also been useful in this compilation

[i] In 1994, the Customs Co-operation Council adopted the working name "World Customs Organization" to reflect its transition to a global intergovernmental organisation. The Convention establishing the Customs Co-operation Council came into force in 1952. The organisation has 174 members (as per 1 July 2009).