Code Shift

The environmental significance of the 2022 amendments to the Harmonized System

IISD REPORT

Ronald P. Steenblik

International Institute for Sustainable Development

May 2020

Published by the International Institute for Sustainable Development

International Institute for Sustainable Development

The International Institute for Sustainable Development (IISD) is an independent think tank championing sustainable solutions to 21st–century problems. Our mission is to promote human development and environmental sustainability. We do this through research, analysis and knowledge products that support sound policymaking. Our big-picture view allows us to address the root causes of some of the greatest challenges facing our planet today: ecological destruction, social exclusion, unfair laws and economic rules, a changing climate. IISD's staff of over 120 people, plus over 50 associates and 100 consultants, come from across the globe and from many disciplines. Our work affects lives in nearly 100 countries. Part scientist, part strategist—IISD delivers the knowledge to act.

IISD is registered as a charitable organization in Canada and has 501(c)(3) status in the United States. IISD receives core operating support from the Province of Manitoba and project funding from numerous governments inside and outside Canada, United Nations agencies, foundations, the private sector and individuals.

Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: www.iisd.org
Twitter: @IISD_news

Code Shift: The environmental significance of the 2022 amendments to the Harmonized System

May 2020

Written by Ronald P. Steenblik

Abstract

This paper highlights the environmental significance of recent changes to the Harmonized Commodity Description and Coding System (HS), approved by members of the World Customs Organization in early 2020. These changes, which will go into effect at the beginning of 2022, facilitate the monitoring of trade in both environmentally sensitive products and "environmental goods"—that is, goods that serve an environmental purpose. Notably, the changes include new commodity codes specific to several technologies that use solar energy and energy-efficient light-emitting diodes. The paper concludes by discussing a number of goods for which greater specification in the HS would facilitate the negotiation of trade agreements aimed at environmental goods and trade statistics collected on those goods. These insights are highly relevant to specialists working on trade or environmental policy, as well as customs authorities.

Key Messages

- The World Customs Organization recently released amendments to the Harmonized Commodity Description and Coding System (HS)—essentially, the language of trade. These changes will be implemented by most of the world's economies on January 1, 2022.
- Many of the changes will facilitate the monitoring of exports and imports of environmentally sensitive products, such as electronic wastes, but also trade in environmental goods, such as solar photovoltaic panels and mass spectrometers.
- This update is a considerable improvement, but the next version of the HS, to be released in 2027, could be further enhanced by creating specific, harmonized codes for a number of goods that will be increasingly important for dealing with the world's pressing environmental problems.

Acknowledgements

The author would like to thank the following individuals and institutions for their valuable comments and recommendations:

- Gael Grooby, Deputy Director of the Tariff and Trade Affairs Directorate, World Customs Organization (WCO)
- George Riddell, Director of Trade Policy (EY)
- Pierre Steenblik, Alternative Energy Finance, Citi
- Peter Wooders, Group Director, Energy, International Institute for Sustainable Development (IISD)

The author also appreciates the corrections and suggestions made by Lisa Muirhead, Director of Editing and Training at Firefly Communications Experts. The opinions expressed and the arguments employed in this update do not necessarily reflect those of the peer reviewers or funders, nor should they be attributed to them. Furthermore, any errors are the fault of the author alone.

Table of Contents

Abbreviations and Acronyms

AC	alternating (electrical) current
APEC	Asia-Pacific Economic Cooperation
Basel Convention	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
DC	direct (electrical) current
CGE	computable general equilibrium (model)
HS	Harmonized Commodity Description and Coding System
LED	light-emitting diode
PV	photovoltaic
Rotterdam Convention	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
UN Comtrade	United Nations Statistical Division Commodity Trade (database)
WCO	World Customs Organization
WTO	World Trade Organization

1.0 Introduction

What's in a number? Plenty if you work on international trade. The numerical codes used by almost every country in the world for classifying exported and imported goods—the Harmonized Commodity Description and Coding System, or HS for short—not only provide the structure for import tariffs but also the basis for the statistics collected on the quantity and value of merchandise trade between countries. Over 98% of global trade in goods is classified with reference to the HS (World Customs Organization [WCO], 2020a). The main message of this paper is that the choice of which goods get specifically described in the HS can also have important ramifications for the environment.

The HS is a hierarchical nomenclature, arranged in a legal and logical structure, that is currently (i.e., since 2017) divided into 21 sections, 97 two-digit chapters, 1,222 four-digit headings, and 5,387 six-digit subheadings. Categories of goods in the HS are called "commodities." The very first listed commodities are pure-bred breeding horses, assigned the code 0101.21 (WCO, 2016). They appear under heading 01.01 ("Live horses, asses, mules and hinnies") in Chapter 1 ("Live animals"). The final listed commodities are "Antiques of an age exceeding one hundred years" (9706.00). All commodities are classified somewhere in the HS, but many fall under headings or subheadings described as simply "Other," which can, in some cases, cover a multitude of distinct products.

Every five years or so, the HS is revised by its custodian agency, the WCO (2018). The seventh revision, which will become the basis for most countries' national tariff schedules starting on January 1, 2022, was recently made public. In its press release accompanying the amendments, the WCO (2020b) noted that "Adaptation to current trade through the recognition of new product streams and addressing environmental and social issues of global concern are the major features of the HS 2022 amendments."

The publication of the amendments to the HS, two years before they take effect, allows customs authorities in each of the WCO's 158 Contracting Parties (plus 53 other countries and customs or economic unions that have not ratified the HS Convention but nonetheless use the HS) to prepare their new tariff schedules, update the materials used for their customs agents, and re-align their statistical databases.

Some of the amendments that are made from one revision to the next are essentially minor edits, such as the removal or insertion of a comma in a commodity description. In other cases, a subheading is subsumed into another one (often "Other"), because the volume of international trade in the good has become too small to merit classifying separately. Such suppression of minor commodities frees up space for new commodities to be distinguished without adding to the size of the HS. Nonetheless, new subheadings have been added at a slightly greater rate than old subheadings have been suppressed such that, with the implementation of HS 2022, their number will have grown by 12% since the first version of the HS was implemented in 1988.

Few lament the disappearance of subheadings for truly minor commodities. But the creation of new subheadings for up-and-coming goods is often eagerly and widely anticipated. Splitting a previous subheading that, for example, covers two very different commodities allows governments to, say, keep the previous import tariff unchanged on one of the commodities but reduce it to zero on the other.

Perhaps even more important, however, is that it means that international trade in those commodities can henceforth be tracked and studied with much greater precision. Trade-flow data, which are collected and organized according to HS codes, are the input variables to the "gravity" (i.e., econometric) and computable general equilibrium (CGE) models that are used to analyze the determinants of trade and explore how trade might change in response to new or modified policies, such as reduced import tariffs.

Without such data, an analyst is left with working on the basis of mere guestimates about the size and pattern of world trade in the affected goods. That makes negotiating sectoral trade agreements more difficult. Since 2002, for example, first the World Trade Organization (WTO) membership in general—and later smaller groups of countries—tried to forge an agreement to liberalize trade in so-called environmental goods, including technologies used for generating electricity from renewable energy.[1] A large share of the goods of interest was, and still is, classified under generic subheadings and not separately identified. This situation has required negotiators to propose goods as "ex-outs"—that is, commodities distinguished within national tariff schedules at the 8-, 10- or even 12-digit level, using descriptions and codes that are not harmonized internationally. One technology on all the lists is (solar) photovoltaic (PV) cells and modules. Yet it has been impossible to inform the negotiations with historical information on actual trade in these solar-energy technologies, as they have been lumped together under the same HS subheading as light-emitting diodes (LEDs), trade in which is also large and growing rapidly.

Over time, a large share of the amendments has been significant for the environment. These amendments fall broadly into two categories: (i) those that respond to the concerns of governments and international organizations that want to better monitor goods that can constitute a threat to the environment and (ii) those that provide more specificity on goods that serve environmental purposes. In recent years, the WCO has concentrated more on the former category by creating new subheadings for ozone-depleting substances, for chemicals that are precursors to the manufacture of illicit drugs or chemical weapons, and for potentially hazardous wastes. The 2022 revisions contain numerous changes of this kind yet again. In addition, they include some changes that should help improve clarity on trade in environmental goods.

The rest of the paper proceeds as follows. Section 2 discusses changes to the HS that facilitate more precise tracking of trade in environmentally sensitive products, namely potentially dangerous chemicals, certain kinds of tropical wood, and hazardous wastes, particularly wastes associated with electrical and electronic products. Section 3 highlights how the 2022 amendments create new subheadings for several types of environmental goods and how those

[1] In 2012 the 21 member economies of the Asia-Pacific Economic Cooperation (APEC) forum concluded an agreement that lowered applied import tariffs on goods under 54 HS subheadings to a maximum ad valorem rate of 5%. Negotiations among 18 WTO economies to forge a plurilateral Environmental Goods Agreement took place between 2014 and 2016 but failed to conclude the deal.

changes can benefit ongoing trade negotiations. Section 4 mentions several other changes to the HS of potential environmental interest, such as the creation of a new subheading for edible insects and several for 3D printers. Section 5 provides suggestions on how the next version of the HS in 2027 could be amended to provide greater specificity for many more goods of environmental interest.

2.0 Environmentally Sensitive Products

2.1 Potentially Dangerous Chemicals

Since HS 1988, several multilateral agreements have been concluded that seek to limit, or at least enable the monitoring of, international trade in particular chemicals, either because of their potentially harmful effects on the environment or on people, because they are narcotics or narcotics precursors, or because they can be turned into chemical weapons. Accordingly, during each period when revisions to the HS are being considered, the WCO has been approached by the secretariat of one or more of these accords with requests for amendments to the HS, usually in Chapters 29 (Organic chemicals) or 38 (Miscellaneous chemical products), in order to reflect the emergence of new compounds or an increase in cross-border movements. The latest revised version of the HS contains numerous such amendments.

The Secretariat for the Montreal Protocol on Substances that Deplete the Ozone Layer, which tracks and controls cross-border movements of ozone-depleting substances, managed to get into the HS 2022 a long list of new or modified subheadings for a range of chemicals, including 12 "derivatives of acyclic hydrocarbons" alone. Several of these chemicals have names decipherable only by chemists, such as "2,3,3,3-tetrafluoropropene (HFO-1234yf)." Similarly, the Secretariat for the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade ("the Rotterdam Convention"), which promotes shared responsibilities in relation to the importation of hazardous chemicals, also requested and obtained several new subheadings in Chapters 29 and 38.

2.2 Tropical Wood

The HS, when it was first created, reflected the commodities dominant in world trade at the time, particularly among the most developed countries. Many products of tropical agriculture and silviculture were not separately identified and were therefore relegated to "Other" subheadings.

Because of the extensive illegal harvesting of lumber from tropical forests, which harms wildlife and can exacerbate climate change, many importing countries take an interest in trade in products made with tropical wood. Timber species whose trade is governed by the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) use the HS codes when determining whether CITES permits are needed on top of other national requirements (see, for example, Annex D of U.S. Department of Agriculture, 2010).

The WCO has thus, over time, added new subheadings for products made from tropical wood in various parts of Chapter 44 ("Wood and articles of wood; wood charcoal"). Responding to a set of proposals submitted by the Food and Agriculture Organization of the United Nations, the HS 2022 contains a new subheading for teak under the heading of "Wood in the rough" (4403.42) and "Wood sawn or chipped lengthwise" (4407.23), as well as subheadings for articles "of tropical wood" under six other product headings, including "Windows, Frenchwindows and their frames" (4418.11), a common use of tropical hardwoods such as idigbo, iroko, mahogany, and utile.

2.3 Hazardous Wastes

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal ("the Basel Convention") restricts transboundary movements of hazardous wastes, except where such movements are deemed to be in accordance with the principles of environmentally sound management, and oversees a regulatory system applying to cases in which transboundary movements are permissible.

Compared with previous revisions, there are relatively few amendments to the HS made in order to assist countries in their work under the Basel Convention. They are significant, nonetheless. A new heading has been added to the end of Chapter 85, "Electrical and electronic waste and scrap" (85.49) along with 11 subheadings under the categories of "Waste and scrap of primary cells, primary batteries and electric accumulators; spent primary cells, spent primary batteries and spent electric accumulators" (8549.11 through 8549.19); "Of a kind used principally for the recovery of precious metal" (8549.21 and 8549.29); "Other electrical and electronic assemblies and printed circuit boards" (8549.31 and 8549.39); and "Other" (8549.91 and 8549.99). The new subheadings distinguish whether the waste products contain glass from cathode-ray tubes or other activated glass (owing to the presence of lead located in the funnel glass), cadmium, lead, mercury, or polychlorinated biphenyls (PCBs), all of which are toxic to humans and other animals. As a consequence, two other subheadings had to be amended to indicate that, in the new edition, they would no longer cover goods included under the new heading: "Cullet and other waste and scrap of glass; glass in the mass" (70.01) and "Waste and scrap of precious metal or of metal clad with precious metal; other waste and scrap containing precious metal or precious metal compounds, of a kind used principally for the recovery of precious metal" (71.12).

3.0 Environmental Goods

Whereas the foregoing changes to the HS relate to traded goods that countries want to track closely because of their potential harmful effects on people or on the environment at large, other changes are intended to improve the tracking of trade in goods that serve an environmental purpose—that is, "environmental goods."

The concept of an environmental good is fairly elastic and not precisely defined. More than two decades ago, the Organisation for Economic Co-operation and Development and Eurostat (1999), the European Union's statistical agency, produced a definition of the environmental goods and services industry that has served essentially as a guideline for determining whether particular goods could qualify as "environmental" for the purpose of tariff reduction:

> The environmental goods and services industry consists of activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use.

In practical terms, what are typically considered as environmental goods are those goods that appear on a large percentage of the nominative lists developed by APEC and WTO member economies for the purpose of trade negotiations. Examples of environmental goods identified in APEC's 2012 agreed list are set out in Annex 1.

Of note is that the nominative lists produced to date include only goods for which the environmental benefit is connected with the good's intrinsic characteristics in use. Goods that might be regarded as environmentally preferable because they have been produced or processed in a relatively clean way (e.g., using renewable energy in their production) but are otherwise indistinguishable from products produced or processed in relatively polluting way (e.g., using fossil fuels in their production) do not make it onto these lists because such distinctions cannot be verified independently by customs agents. Similarly, the HS itself differentiates products according to how they were made for only a few manufactured goods. For example, a trained customs agent can distinguish "'Helem', 'Schumacks', 'Karamanie' and similar hand-woven rugs" (5702.10) from machine-woven rugs by examining their warp and weft.

A persistent irritant has been that few of the HS's 6-digit subheadings specifically cover goods that are mainly used for environmental purposes. To get around the "specificity" problem, trade negotiators have had to name the product and the subheading under which it is classified, and then tag it with the phrase "ex-out," leaving it up to each economy to create a specific code for that commodity at the 8- or 10-digit level in their national tariff schedules, which are not internationally harmonized beyond the first 6 digits.[2]

[2] Alternatively, a country can decide simply to apply the agreed new reduced or zero tariff to all the goods covered by the applicable 6-digit subheading. Often, however, goods that are not considered "environmental" will also be covered by that action.

Having a technology specifically described and coded in the HS makes the negotiation process easier and quicker. By contrast, when ex-outs are used, participants at the start of the negotiations may have slightly different descriptions of those technologies in their national tariff schedules and must therefore negotiate a commonly agreed description.

Consider solar water heaters, which currently are classified under subheading 8419.19 ("Instantaneous or storage water heaters, non-electric – Other") in the HS, which also covers storage water heaters that use a fossil fuel (petroleum, natural gas, or liquefied propane gas) as their energy source. China has an 8-digit code for solar water heaters (8419.19.10), whereas the United States differentiates them at the 10-digit level (8419.19.00.40). Costa Rica goes even deeper, assigning a 12-digit code (8419.19.00.00.20) to them. Switzerland does not separately identify solar water heaters in its national tariff schedule, using its 8-digit codes under that subheading instead to differentiate other non-electric instantaneous or storage water heaters by the type of metal with which they are constructed (iron or steel other than stainless steel, aluminum, or other). New Zealand, by contrast, differentiates its "other" water heaters by their liquid capacity—specifically, whether or not that capacity exceeds 200 litres. Fiji, Iceland, and Norway make no distinctions among "other" non-electric instantaneous or storage water heaters.

The 2022 revisions to the HS recognize that several of the current subheadings do not adequately represent recent technological advances relating to environmental goods, leaving a lack of trade statistics important to the industries and increasing the potential for classification difficulties. The changes include several amendments that separate several of these goods from previous subheadings that covered other goods as well, often not of environmental interest. These new subheadings will make easier the task of trade negotiators, especially those who are in the process of nominating specific environmental goods for tariff elimination as part of the six-nation Agreement on Climate Change, Trade and Sustainability (ACCTS).[3] Eliminating tariffs on environmental goods, especially those important for reducing emissions of carbon dioxide from the combustion of fossil fuels, should be one of the easiest and most cost-effective ways for countries to address climate change.

3.1 Catalytic Converters

Surprisingly, given that they were first deployed on automobiles in the mid-1970s, catalytic converters—devices that reduce toxic gases in exhaust gases emitted by internal combustion engines—have heretofore never been separately identified in the HS. In the HS 2022 they are at least mentioned by name, though they will share the new subheading (8421.32) with "particulate filters … for purifying or filtering exhaust gases from internal combustion engines," presumably because sometimes the two functions are combined in one device. Particulate filters, which filter out most of the particles emitted by diesel engines, have been installed on many off-road machines since 1980 and in automobiles since 1985.

[3] See Steenblik & Droege (2019). The original five negotiating parties were Costa Rica, Fiji, Iceland, New Zealand, and Norway. Subsequently, Switzerland has joined the initiative.

3.2 Devices for Converting Solar Energy to Heat or Electricity[4]

Panels that use the sun's infrared radiation to heat water have been included on most candidate lists of environmental goods for decades, but necessarily as a sub-subheading of "Instantaneous or storage water heaters, non-electric – Other" (8419.19). The HS 2022 finally creates a new subheading specifically for solar water heaters (8419.12). According to United Nations Statistical Division Commodity Trade (UN Comtrade) data,[5] world imports of non-electric instantaneous or storage water heaters have ranged between USD 1.5 billion and USD 1.8 billion a year over the past decade. A significant portion of that trade is likely to have been natural-gas-fuelled water heaters. As a point of reference, Grand View Research (2018) estimates that the global market (including domestic sales) for solar water heaters was worth an estimated USD 2 billion in 2016 and is projected to grow at an annual rate of 8.5% through 2025.

Even more important is the separating out of PV cells from LEDs—heretofore lumped together in one subheading—through the creation of two subheadings: one for PV cells that are not assembled in modules or made up into panels (8541.42) and one for those that are (8541.43). World trade in photosensitive semiconductor devices, a category in HS 2017 that includes both PV cells, modules, and panels *and* LEDs, averaged more than USD 50 billion a year in the decade prior to 2018 (Figure 1), making it the 48th leading product category (out of 5,386) in 2018.

Estimates of the PV cells and modules component of that trade are necessarily rough, but it could easily have accounted for half of the total. Gupta and Bais (2016), for example, give a figure of USD 35 billion for the global value of the solar PV cells and modules market in 2015. In the case of both solar PV cells and LEDs, a relatively high proportion of total production enters international trade. Ex-factory gate (spot) prices for multicrystalline-silicon PV modules have fallen steadily, in nominal terms, from about USD 2.50 per watt to USD 0.30 at the beginning of 2018 (Austin, 2019). Over the same period, world production of PV cells and modules, as measured in gigawatts (GW) of rated electrical output, more than quintupled, to 114 GW (Jäger-Waldau, 2019, p. 5). Globally, solar PV cells are by far the leading technology for new additions to electricity-generating capacity and are expected to keep that position over the next decade at least.

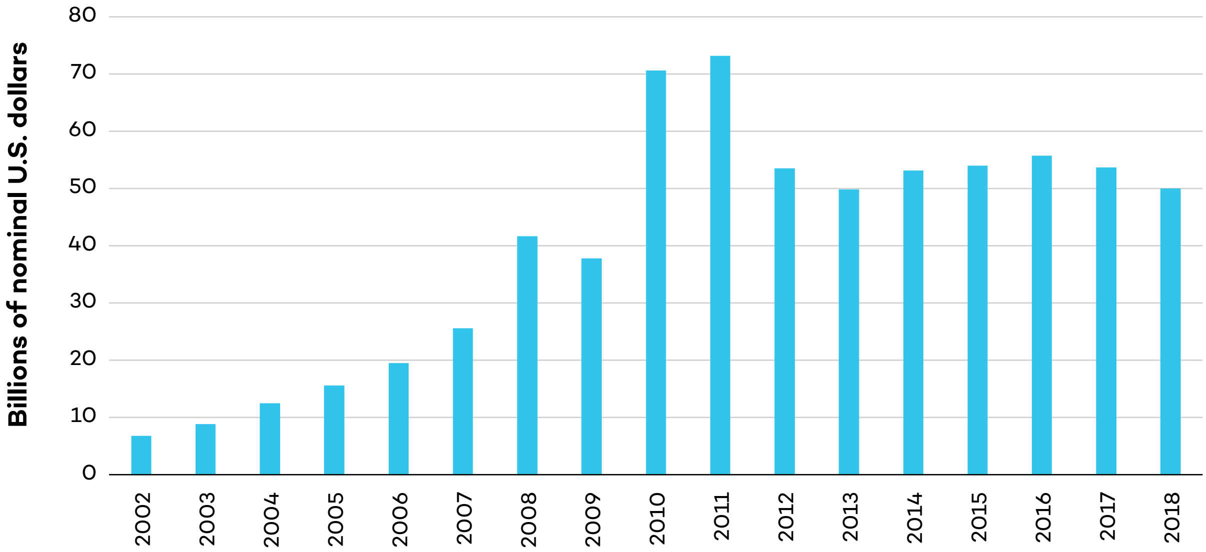
Three new subheadings have also been created for PV electric generators: those that produce direct current (DC) and have a rated maximum capacity not exceeding 50 megawatts (MW) (HS 8501.71); those that produce DC and have a rated capacity exceeding 50 MW (8501.72); and photovoltaic alternating current (AC) electric generators of any rated capacity (8501.80). PV generators refer to stand-alone plants and are distinguished from PV cells that are made up into panels by their being combined with other apparatus, such as storage batteries and electronic controls (voltage regulators, inverters, etc.) and panels or modules equipped with

[4] These changes were proposed by the International Renewable Energy Agency (IRENA).

[5] All world trade data cited in this paper have been obtained from the UN Comtrade database, accessed via the World Integrated Trade Solution (WITS) database: http://wits.worldbank.org/WITS/WITS//Default-A.aspx?Page=Default.

elements (e.g., diodes to control the direction of the current) that supply power directly to, for example, a motor or an electrolyzer, or allow them to be connected to an electrical grid.

Figure 1. World net imports of photosensitive semiconductor devices, including PV cells, modules and panels, and LEDs (HS 8541.40), 2002–2018



Data source: World Integrated Trade Solution, 2020.

3.3 Furnaces and Ovens for Treating Waste Products or Pollutants

APEC included several types of furnaces and ovens in its 2012 list of environmental goods, particularly waste incinerators and heat or catalytic incinerators classified under HS subheadings 8514.10, 8514.20, and 8514.30. The recent amendments have created three new subheadings of interest.

One is for "Hot isostatic presses" (8514.11). These are presses that, at a high temperature, apply a high, uniform pressure in all directions to a mixture of materials (e.g., a waste product with a resin) to create a more consolidated and denser ceramic or other composite. Among other applications, it is used for the treatment and conditioning of radioactive waste (Garamszeghy, 2011).

The other two new subheadings are for "Electron beam furnaces" (8514.31) and "Plasma and vacuum arc furnaces" (8514.32). Electron beam furnaces are used for, among other applications, the recovery of metals from scrap, including electronic waste (Sundqvist Ökvist, 2016). One such metal is tantalum, which is highly resistant to corrosion and non-toxic to humans. Some tantalum alloys are extremely strong and, for this reason, have been used in blades for gas turbines. An alloy of tantalum (Ta) with niobium (Nb), hafnium (Hf), zirconium (Zr), and titanium (Ti) has recently been shown to conduct electricity with zero resistance (i.e., superconduct) across a wide range of pressures (Guo et al., 2017).

Superconducting materials reduce electricity losses during transmission and distribution, increasing the total efficiency of power supply.

Plasma arc furnaces are devices that heat substances via plasma flow, typically created by an electric plasma arc, or plasmatron, which is like a giant welding torch (Svirchuk, 2011; Woodford, 2019). Plasma arc waste-disposal systems are under development to replace conventional waste incinerators. Instead of burning the waste (at a few hundred degrees Celsius), the waste is heated to thousands of degrees Celsius, which vaporizes it. As described by Woodford (2019), after undergoing such treatment:

> Simple organic (carbon-based) materials cool back down into relatively clean gases; metals and other inorganic wastes fuse together and cool back into solids. In theory, you end up with two products: syngas (an energy-rich mixture of carbon monoxide and hydrogen) and a kind of rocky solid waste not unlike chunks of broken glass. The syngas can be piped away and burned to make energy (some of which can be used to fuel the plasma arc equipment), while the "vitrified" (glass-like) rocky solid can be used as aggregate (for roadbuilding and other construction). In practice, the syngas may be contaminated with toxic gases such as dioxins that have to be scrubbed out and disposed of somehow, while the rocky solid may also contain some contaminated material.

Vacuum arc furnaces are electric furnaces that directly heat a metal in the presence of a vacuum. One application is recycling (by remelting) metals such as hafnium, molybdenum, niobium, tantalum, titanium, tungsten, and zirconium (Jones et al., 2003).

3.4 LEDs[6]

LEDs, which are semiconductor light sources, saw early use in the 1960s, first as individual indicator lamps or as components of electronic displays. It was not until the 2010s, however, that they began to be assembled into fully-fledged light sources or luminaires and sold commercially as alternatives to incandescent and fluorescent light sources. Since the early part of the decade, their sales and trade have skyrocketed. A recent study by the European Commission cites estimates that global unit shipments of LED lamps will have grown from 68 million pieces in 2013 to almost 1.3 billion by 2021 (Zissis & Bertoldi, 2018, p. 12).

LED light sources are of major environmental importance because they require 90% less electricity than incandescent lamps ("light bulbs"), providing an equivalent level of light. They also operate 10 times as long as incandescent lamps before they have to be replaced, thereby saving on maintenance costs and reducing solid waste.

The 2017 revisions to the HS created new subheadings for LED lamps, as distinct from the individual diodes. The 2022 revisions go further by giving the diodes their own subheading (8541.41), which they no longer have to share with PV cells. In addition, HS 2022 creates new subheadings for LED light sources, either in the form of modules (8539.51) or lamps (8539.52). "Lamps" in the HS refer to what in the vernacular of some countries are called

[6] These changes were proposed by the International Renewable Energy Agency (IRENA).

"light bulbs," not fittings for light sources. However, and a bit confusingly, portable electric lamps (also known in some configurations as torches or flashlights) *are* called lamps.

As for other lighting fittings, HS 2022 also creates new subheadings for several types of luminaires designed for use solely with LED light sources:

- "Chandeliers and other electric ceiling or wall lighting fittings, excluding those of a kind used for lighting public open spaces or thoroughfares" (9405.11)
- "Electric table, desk, bedside or floor-standing luminaires" (9405.21)
- "Lighting strings used for Christmas trees" (9405.31)
- "Other electric luminaires and lighting fittings" (9405.41)
- and even "Illuminated signs, illuminated name-plates and the like" (9405.61).

An additional subheading has also been created for electric luminaires and lighting fittings designed for use solely with LED light sources that are powered by integrated PV cells or modules (9405.41). This category would cover, for example, PV-powered light sources of a kind used for illuminating public open spaces or thoroughfares (i.e., streetlamps).

3.5 Electrified Vehicles

Several types of electric and hybrid-electric motor cars and motorcycles were first separately identified in the revisions that produced the current HS (2017). HS 2022 creates several more categories, including fully or partially electrified "road tractors for semi-trailers" (i.e., the "big rigs" of lore that pull trailers laden with goods) under heading 87.01 and non-articulated trucks or lorries used for transporting goods under heading 87.04.

In the view of many transport experts, electric-drive technologies for heavy-duty vehicles will be essential for fully decarbonizing transport. According to Moultak et al. (2017), heavy-duty freight trucks represent less than 10% of all vehicles in the world but roughly 40% of carbon emissions from vehicles. Because they rely mainly on diesel, trucks are also major sources of urban particulate emissions. Compared with heavy-duty vehicles powered by diesel engines, electric-drive technologies powered by renewable sources can achieve more than an 80% reduction in fuel life-cycle carbon emissions (Moultak et al., 2017). Several major vehicle manufacturers are currently working to electrify delivery and distribution trucks in the coming years (Downing, 2020).

3.6 Mass Spectrometers

Mass spectrometers are laboratory instruments that are used to identify unknown compounds, quantify known compounds, or characterize the structure and chemical properties of molecules (Broad Institute, n.d.). They are used extensively in environmental monitoring, such as to detect toxins and identify trace contaminants in food, water, or soil.

The 2022 HS amendments divide a previous subheading for "other instruments and apparatus" into two new subheadings: "mass spectrometers" (9027.81) and "Other [instruments and apparatus]" (9027.89).

4.0 Other Amendments of Environmental Interest

4.1 Edible Insects

One signal change starting in 2022 will be the addition of "edible, non-living insects" to several areas of the HS, particularly Chapter 4, where they get a special mention (0410.10). Locally harvested insects have been used as food by many cultures around the world for millennia, but thanks to edible insects gaining popularity in Western cultures, including by those interested in alternatives to meat, trade in dead bugs has finally passed the minimum threshold to qualify for its own distinct subheading. Insects and mealworms (the larvae of mealworm beetles) are much more efficient converters of vegetable matter into protein than are mammalian sources of meat and can be grown in smaller spaces. Per kilogram of protein, crickets emit only one gram of greenhouse gases, compared with 300 grams for chicken and almost 3,000 grams for beef (Vrachovska, 2019).

4.2 Microbial Fats and Oils

"Microbial fats and oils" also emerge from "otherdom" and get inserted into several places in the HS where products previously containing only animal or vegetable fats or oils were classified. Polyunsaturated fatty acids produced by microbes such as fungi or microalgae were first marketed in the 1980s and had to be extensively tested to ensure that they were not toxic when ingested by humans. They are now sold as nutraceuticals (foods that allegedly provide medicinal or health benefits) in foods for humans, pets, farmed animals, and fish. They have also been used to produce feedstock for making biofuels, albeit so far only in small quantities. Nevertheless, they now get a mention in the revised Note 7 to Chapter 38, which defines the term "biodiesel" (38.26). As a biodiesel feedstock, microbial oil has some environmental advantages over crop-derived oils, mainly because its production need not take place on arable land.

4.3 Carbon Fibres

HS 2022 replaces the subheading "Non-electrical articles of graphite or other carbon" (6815.10) with a new, expanded set of subheadings that include carbon fibres (6815.11), articles of carbon fibres for non-electrical uses (6815.12), and other articles of carbon fibres (6815.13). This greater specification enables more information to be collected on trade in articles made from carbon fibre, which is a material that is increasingly being used as a substitute for heavier metals or glass composites in the manufacture of aircraft, automobiles, and wind-turbine blades. Owing to its high strength-to-weight ratio, carbon fibre helps improve the fuel economy of aircraft and automobiles, fortify sails, and, when used in the construction of wind-turbine blades, improves the performance of these renewable-energy devices.

4.4 3D Printers

A new heading has been created also for “Machines for additive manufacturing” (84.85)—that is, 3D printers—with specific subheadings to distinguish machines that deposit metals; plastics or rubber; and plaster, cement, ceramics, or glass. Additive manufacturing, which enables anybody with the requisite machine and digital template to “print” (i.e., build up an object by depositing multiple layers of a liquefied material) three-dimensional objects, is a potentially disruptive technology that, in theory, could have a huge impact on trade. In a world in which the manufacturing of complex machines often involves assembling components produced in a multitude of factories located around the world, being able to print components on-site rather than import them could reduce cross-border movements in the types of manufactured goods for which this technology is best suited.

Moreover, the technology could level the playing field in manufacturing, enabling developing countries to move up the value chain by producing more varied and sophisticated goods, as the requisite knowledge is embodied in the digital instructions for the printers, which also require less of an up-front investment of cash and training than do the array of machine tools that they replace.

5.0 Toward the Next Revision of the HS

The next revision of the HS, its eighth, will not be finalized until approximately five years from now. By November 2019, the Review Sub-Committee of the WCO's HS Committee had already started considering anew what amendments to the HS may need to be made when a new version of the HS starts to be applied in the year 2027. It is therefore not too early to start thinking about what a wish list of environmentally motivated changes might look like.

The expansion of the HS between the 2017 and 2022 versions was one of the biggest to date, with the net addition of 6 new headings and 222 subheadings, which might suggest a willingness of the WCO to keep adding new commodity descriptions to the HS. However, the WCO, like most other intergovernmental organizations, is innately conservative: it decides matters by consensus and is not prone to radical change. Each revision of the HS is thoroughly discussed by committees comprised of member government delegates, who have the last word on any proposed changes. Accordingly, the pace of additions to the HS over time has more often been modest, and even some commodities that meet the HS's minimum threshold for separate specification (USD 1 million in world trade annually) have had to wait several revision cycles before being assigned their own distinct code.

Nevertheless, to quote the musician Stevie Wonder, "If you don't ask, you don't get" (Cosmo, 2016). So what follows is a very partial list of asks for consideration by the Review Sub-Committee of the WCO as they start thinking about the next round of revisions to the HS. The list here concentrates on environmental goods, leaving questions about what, if any, additions may be necessary to implement the Basel Convention, the Montreal Protocol, or the Rotterdam Convention to the experts from their respective secretariats.

5.1 Silicon Semiconductor Wafers for PV Cells

Currently classified under 3818.00, these vital substrates for PV cells currently share a subheading with all "Chemical elements doped for use in electronics, in the form of discs, wafers or similar forms; chemical compounds doped for use in electronics," a category that includes (judging from Chinese Taipei's national tariff schedule [European Commission, 2020][7]), wafers of mono- or poly-crystalline silicon, germanium, gallium arsenide, gallium phosphide, gallium phosphide arsenide, indium arsenide, or gallium aluminum arsenide. With global trade under this heading worth USD 16.5 billion in 2018—a year-on-year increase of more than 15%—distinguishing among silicon, germanium, and gallium arsenide wafers, and "other" chemical elements doped for use in electronics, in the form of discs, wafers or similar forms, should be possible.

[7] Note: The European Commission Market Access Database is accessible only from an EU Member State.

5.2 Wind-Powered Water Pumps; Solar-Powered Water Pumps

The HS heading that covers "Pumps for liquids, whether or not fitted with a measuring device; liquid elevators" (84.13) contains 10 subheadings that distinguish different types of pumps irrespective of what powers them (apart from 8413.20: hand pumps). Both wind-powered and solar-powered pumps serve many remote areas where connection to an electricity grid is not an option, particularly for irrigation, for which pumps powered by small diesel engines would otherwise be used (Grand View Research, 2016). HS heading 84.13 is already fairly congested, but perhaps some space could be created so as to enable subheadings for pumps designed to be powered by renewable energy.

5.3 Pollution-Control Devices for Treating Flue Gases, not Elsewhere Specified

Several types of pollution-control devices are separately identified in the HS, including machinery and apparatus for filtering or purifying water (8421.21), oil or petrol-filters for internal combustion engines (8421.23), and—with the implementation of HS 2022—catalytic converters. However, there are numerous large-scale devices that are used commonly by industrial plants and power plants—to control substances like soot, sulphur oxides, or nitrous oxides emitted in flue gases—that are today still merely covered by HS 8421.39: "Other" filtering or purifying machinery and apparatus for gases.

There is no technical reason why more air-pollution-control devices could not be added to the HS. China, for instance, separately identifies several at the 8-digit level within its national tariff schedule (Table 1).

Table 1. Pollution-control equipment for treating flue gases that are listed in China's national tariff schedule

National tariff code	Description
8421.39.2	- - - Dust collectors for industrial uses:
8421.39.21	- - - - Electrostatic
8421.39.22	- - - - Bag filter
8421.39.23	- - - - Cyclone
8421.39.24	- - - - Electric bag composite dust collectors
8421.39.40	- - - Flue-gas desulphurization devices
8421.39.50	- - - Flue-gas denitration devices

Source: European Commission (2020). Note: This database is accessible only from an EU Member State.

These pollution-control devices sell for millions of U.S. dollars apiece and, when measured in terms of the number of units, are not traded widely. However, that trade under HS 8421.39 has grown strongly over the last 15 years, reaching USD 23 billion in 2018, certainly suggests that it is large enough to merit more precise differentiation among the pollutants targeted by various types of machinery and apparatus for filtering or purifying gases.

The problem with creating new subheadings under HS 8421.3 is that there is space for only six more subheadings between HS 8421.32 and HS 8421.39. That could at least allow for the creation of subheadings for the devices listed in Table 1. Alternatively, a new five-digit subheading could be created at, say, HS 8421.4 and populated by eight new six-digit subheadings (plus 8421.49 for "Other").

5.4 Ground-Source Heat Pumps and Hydrothermal Heat Pumps

Heat pumps are electrical machines that transfer heat to or from the ground, water, or air. They comprise a motor-driven fan and elements for changing the temperature and sometimes also humidity. A refrigerator is a type of heat pump. Normally, however, the term "heat pump" preceded by the medium of heat exchange refers to a *reversible* heat pump—that is, an appliance that can pump heat from inside a building to the outside (to cool its air) and from the outside to the inside (for space heating or water heating).

Ground-source heat pumps require a ground heat-exchange loop in addition to the heat pump itself. Along with hydrothermal heat pumps (which immerse the heat-exchange loop in water), they are much more energy efficient than air-source heat pumps, which currently dominate the market. Currently, reversible heat pumps with a motor-driven fan and elements for changing both the temperature and the humidity used for heating and cooling buildings are grouped under one HS subheading (8415.81): "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: - Other: - - Incorporating a refrigerating unit and a valve for reversal of the cooling/heat cycle (reversible heat pumps)." Other heat pumps, whether compression or absorption heat pumps, which are often used for heating buildings or hot water, are classified under a different heading and subheading (8418.61): "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: - - Heat pumps other than air conditioning machines of heading 84.15." A restructuring of HS 8415.8 and HS 8418.6 could create space to distinguish among the leading heat-pump technologies.

5.5 Electrolyzers

These devices use an electric current to split water molecules into its two elemental gases, hydrogen (H_2) and oxygen (O_2). Recombining hydrogen with oxygen is how electricity is produced in a fuel cell. There is also considerable interest in substituting hydrogen gas—which already has its very own subheading (2804.10)—for natural (i.e., fossil) gas as a way to reduce carbon dioxide emissions, which should increase trade in devices used to make it. Creating a new subheading for electrolyzers could be done by inserting a code between 8543.30 (“Machines and apparatus for electroplating, electrolysis or electrophoresis”) and 8543.70 (“Other machines and apparatus”).

5.6 Fuel Cells

A fuel cell functions, essentially, opposite to an electrolyzer: it is a device that generates electricity by combining hydrogen with oxygen, in the process creating water (H_2O). Fuel cells are already being used to power some electric buses, trucks, and high-end passenger vehicles. Some are even being used to power and heat homes. The market-research firm Grand View Research (2020a) estimates the size of the global fuel-cell market at USD 10.5 billion in 2019, with stationary fuel cells accounting for about 70% of sales by volume. It expects the market for all types of fuel cells to grow at a 15.5% compound annual growth rate through 2027. Currently, fuel cells are classified under heading 85.01 as they continuously generate, rather than store, energy. But in some parts of the world, they are traded under 8506.80 (“Other primary cells and primary batteries”). Perhaps a clarification of the classification of fuel cells could be made in the terms of the headings, and new subheadings could be created to separately provide for fuel cells.

5.7 Electric-Powered and Hybrid-Electric Aircraft

Chapter 88 (“Aircraft, spacecraft, and parts thereof”) distinguishes only between “non-powered aircraft” (88.01) and “other aircraft” (88.02), which are presumed to be powered. Considerable research and development have been directed at hybrid-electric and fully electric aircraft in recent years, and already several air-worthy prototypes have been built. By the late 2020s, a global market in electrified aircraft will have likely taken off (Grand View Research, 2020b). Already, the HS 2022 has anticipated a growing market for “Unmanned aircraft – Designed for the carriage of passengers,” even though international trade in such aircraft has, to date, been minuscule. Further distinguishing among both piloted and unpiloted aircraft by propulsion energy source would be helpful.

5.8 Electric-Powered and Hybrid-Electric Ships, Boats, Barges, Ferries, and Similar Vessels

As with electrified aircraft, there is considerable interest in electrifying watercraft in order to reduce air pollution and greenhouse gas emissions associated with the combustion of fossil fuels for vessel propulsion. Some of the first commercial boats to be converted to run solely on electric-battery power have been car ferries (Butler, 2019). Other potential markets would be for water buses and water taxis, displacing those currently powered by diesel engines (e.g., as can be found plying canals, rivers, or bays around Bangkok, Geneva, New York, and Venice). Chapter 89 (“Ships, boats and floating structures”) does not distinguish watercraft by their means of propulsion, apart from “Sailboats, with or without auxiliary motor” (8903.91). Separately identifying electric-powered and hybrid-electric vessels under subheading 8901.1 (“Cruise ships, excursion boats and similar vessels principally designed for the transport of persons; ferry boats of all kinds”) and 8901.9 (“Other vessels for the transport of goods and other vessels for the transport of both persons and goods") could conceivably be done, however.

The foregoing lists just a small sample of products for which greater resolution in the HS would help policy-makers, market analysts, and participants in the environmental goods and services industries better understand and more quickly identify emerging trends in the trade of some of the most important goods. In the meantime, we can look forward to new statistics on trade in the products separately identified in the HS for the first time, as they begin to be collected and published, starting in 2023.

References

Asia–Pacific Economic Cooperation. (2012, September 8). *Annex C – APEC list of environmental goods.* https://www.apec.org/Meeting-Papers/Leaders-Declarations/2012/2012_aelm/2012_aelm_annexC.aspx

Austin, R. (2019, July 2). Solar energy costs trends over time. *Earthtechling.* https://earthtechling.com/solar-energy-costs-trends/

Broad Institute. (n.d.). *What is mass spectrometry?* https://www.broadinstitute.org/proteomics/what-mass-spectrometry

Butler, J. (2019, January 27). *Norway leads an electric ferry revolution.* Plugboats. https://plugboats.com/norway-leads-an-electric-ferry-revolution/

Cosmo, L. L. (2016, February 12). *Rock love quote: 5000 Quotations on rock n' roll of legends, bands, producers, instrumentalists, writers and leading vocals.* Lulu Press, Inc.

Downing, S. (2020, January 13). *8 electric truck and van companies to watch in 2020.* GreenBiz. https://www.greenbiz.com/article/8-electric-truck-and-van-companies-watch-2020

European Commission. (2020). *Market Access Database.* https://madb.europa.eu/madb/indexPubli.htm

Garamszeghy, M. (2011). Compaction processes and technology for treatment and conditioning of radioactive waste. In M. I. Ojovan (Ed.), *Handbook of advanced radioactive waste conditioning technologies* (pp. 19–42). Woodhead Publishing. https://doi.org/10.1533/9780857090959.1.19

Guo, J., Wang, H., von Rohr, F., Wang, Z., Cai, S., Zhou, Y., Yang, K., Li, A., Jiang, S., Wu, Q., Cava, R. J., & Sun, L. (2017, December). Robust superconductivity in a high-entropy alloy. *Proceedings of the National Academy of Sciences, 114* (50), 13144–13147. https://doi.org/10.1073/pnas.1716981114

Gupta, A. & Bais, A. S. (2016, December). *Solar cells market size by technology (crystalline silicon cells, thin film cells, ultra-thin film cells), by product (polycrystalline, monocrystalline, cadmium telluride (CDTE), amorphous silicon (A-SI), copper indium gallium diselenide), by grid (on-grid, off grid), by application (residential, commercial, utility), industry analysis report, regional outlook, growth potential price trends, competitive market share & forecast, 2016–2024.* Global Market Insights. https://www.gminsights.com/industry-analysis/solar-cells-market

Grand View Research. (2016, May). *Solar pumps market analysis by product (DC surface suction, AC submersible, DC submersible and AC floating), by application (agriculture and drinking water) and segment forecasts to 2022.* https://www.grandviewresearch.com/industry-analysis/solar-pumps-market

Grand View Research. (2018, May). *Solar water heaters market size, share & trends analysis report, by technology (ETC, FPC, UWC), by application (residential, commercial, industrial), by system, by region, and segment forecasts, 2018–2025.* https://www.grandviewresearch.com/industry-analysis/solar-water-heaters-market

Grand View Research. (2020a, February). *Fuel cell market size, share & trends analysis report by raw material, by product (PEMFC, PEFC, SOFC, MCFC), by application (stationary, transportation, portable), and segment forecasts, 2020–2027.* https://www.grandviewresearch.com/industry-analysis/fuel-cell-market

Grand View Research. (2020b, forthcoming). *Electric aircraft market size, share & trends analysis report by application, regional outlook, competitive strategies, and segment forecasts, 2019 to 2025.* https://www.grandviewresearch.com/industry-analysis/the-global-electric-aircraft-market

Jäger-Waldau, A. (2019, November). *PV status report 2019* (Joint Research Centre Science for Policy Report). European Commission. https://ec.europa.eu/jrc/sites/jrcsh/files/kjna29938enn_1.pdf

Jones, P.L., Taylor, S. Nakai, S., & Jennings, J. (2003). Electroheat and materials processing. In M.A. Laughton and D.J. Warne (Eds.), *Electrical engineer's reference book* (16th ed., pp. 9-1-9-38.). Newnes Books. https://doi.org/10.1016/B978-075064637-6/50009-5

Moultak, M., Lutsey, N., & Hall, D. (2017, September). *Transitioning to zero-emission heavy-duty freight vehicles* (White Paper). International Council on Clean Transportation. https://theicct.org/sites/default/files/publications/Zero-emission-freight-trucks_ICCT-white-paper_26092017_vF.pdf

Organisation for Economic Co-operation and Development & Eurostat. (1999). *The environmental goods and services industry: Manual for data collection and analysis.* OECD Publishing. https://doi.org/10.1787/9789264173651-en

Steenblik, R. P. & Droege, S. (2019, September 25). *Time to ACCTS? Five countries announce new initiative on trade and climate change.* International Institute for Sustainable Development. https://www.iisd.org/blog/time-accts-five-countries-announce-new-initiative-trade-and-climate-change

Sundqvist Ökvist, L., Ye, G., Hu, X., Yang, T. (2016, May). *State of the art on the recovery of refractory metals from secondary resources.* Multi-Stakeholder Platform for a Secure Supply of Refractory Metals in Europe (MSP-REFRAM). http://prometia.eu/wp-content/uploads/2016/08/MSP-.EFRAM-D3.2-State-of-the-art-on-the-recovery-of-refractory-metals-from-secondary-resources.pdf

Svirchuk, Ye. S. (2011, February 2). Plasma arc furnace. *Thermopedia.* https://doi.org/10.1615/AtoZ.p.plasma_arc_furnace

U.S. Department of Agriculture. (2010). *CITES I-II-III Timber Species Manual.* U.S. Government Publishing Office. https://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/cites.pdf

Vrachovska, M. (2019). *12 reasons why you should start eating BUGS.* Crickster™. https://www.eatcrickster.com/blog/reasons-to-eat-bugs

Woodford, C. (2019, February 12). *Plasma arc recycling.* https://www.explainthatstuff.com/plasma-arc-recycling.html

World Customs Organization (WCO). (2016). *The Harmonized Commodity Description and Coding System – 2017* (6th ed.). http://www.wcoomd.org/en/topics/nomenclature/instrument-and-tools/hs-nomenclature-2017-edition/hs-nomenclature-2017-edition.aspx

World Customs Organization. (2018, December). *The Harmonized System: A universal language for international trade.* http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/nomenclature/activities-and-programmes/30-years-hs/hs-compendium.pdf?la=en

World Customs Organization. (2020a, January 8). *The new 2022 edition of the Harmonized System has been accepted.* http://www.wcoomd.org/en/media/newsroom/2020/january/the-new-2022-edition-of-the-harmonized-system-has-been-accepted.aspx

World Customs Organization. (2020b, January 29). *WCO has published accepted amendments to HS 2022.* http://www.wcoomd.org/en/media/newsroom/2020/january/wco-has-published-accepted-amendments-to-hs-2022.aspx

World Integrated Trade Solution. (2020). UN Comtrade. http://wits.worldbank.org/WITS/WITS//Default-A.aspx?Page=Default

Zissis, G. & Bertoldi, P. (2018). *Status of LED-lighting world market in 2017* (Joint Research Centre Technical Reports). European Commission. https://e3p.jrc.ec.europa.eu/sites/default/files/documents/publications/jrc113302_status_of_led_lighting_world_market_in_2017_bertoldi_v3_no_identifiers-1.pdf

Annex 1. Environmental Goods Included in APEC's 2012 List That Are Affected by the 2022 Amendments to the HS

HS version			HS (2012) code description	Optional ex-out(s) or additional product specification	Environmental benefit
2002	**2007**	**2012**			
841919	841919	841919	Instantaneous or storage water heaters, non-electric (other than instantaneous gas water heaters)	Solar water heaters	Uses solar thermal energy to heat water, producing no pollution. Use of solar water heating displaces the burning of other, pollution-creating fuels.
842139	842139	842139	Filtering or purifying machinery and apparatus for gases (other than intake air filters for internal combustion engines)	Catalytic converters	Catalytic converters convert harmful pollutants, like carbon monoxide (CO), into less harmful emissions.
850164	850164	850164	AC generators (alternators), of an output exceeding 750 kVA	Plants using generators to produce electricity from renewable energy	Alternating current (AC) generators connected to renewable energy sources provide cleaner energy than those powered by fossil fuels.*

HS version			HS (2012) code description	Optional ex-out(s) or additional product specification	Environmental benefit
2002	2007	2012			
851410	851410	851410	Resistance-heated furnaces and ovens	Waste incinerators and heat or catalytic incinerators	These products are used to destroy solid and hazardous wastes. Catalytic incinerators are designed for the destruction of pollutants (such as volatile organic compounds [VOCs]) by heating polluted air and oxidizing organic components.
851430	851430	851430	Other furnaces and ovens	Waste incinerators and heat or catalytic incinerators	Catalytic incinerators are designed for the destruction of pollutants (such as VOCs) by heating polluted air and oxidizing organic components.
854140	854140	854140	Photosensitive semiconductor devices, including photovoltaic (PV) cells whether or not assembled in modules or made up into panels; light-emitting diodes	PV cells, modules, and panels	Solar PV cells generate electricity with no emissions, noise or heat generated. They are particularly suited to electricity generation in locations remote from an electricity grid.

HS version			HS (2012) code description	Optional ex-out(s) or additional product specification	Environmental benefit
2002	**2007**	**2012**			
902780	902780	902780	Instruments and apparatus for physical or chemical analysis not elsewhere specified in 90.27	Instruments for analyzing noise, air, water and hydrocarbons, and heavy metals in soil	These instruments include: mass spectrometers, which are used to identify elements and compounds, and to measure, record, analyze, and assess environmental samples or environmental influences.

*Note: the original Asia-Pacific Economic Cooperation list specified only AC generators to be "used in conjunction with boiler and turbines to generate electricity in renewable energy plants" fuelled by biomass.

Source: Adapted from Asia-Pacific Economic Cooperation, 2012.

Published by the International Institute for Sustainable Development.

Head Office

111 Lombard Avenue, Suite 325
Winnipeg, Manitoba
Canada R3B 0T4

Tel: +1 (204) 958-7700
Website: www.iisd.org
Twitter: @IISD_news

IISD

iisd.org