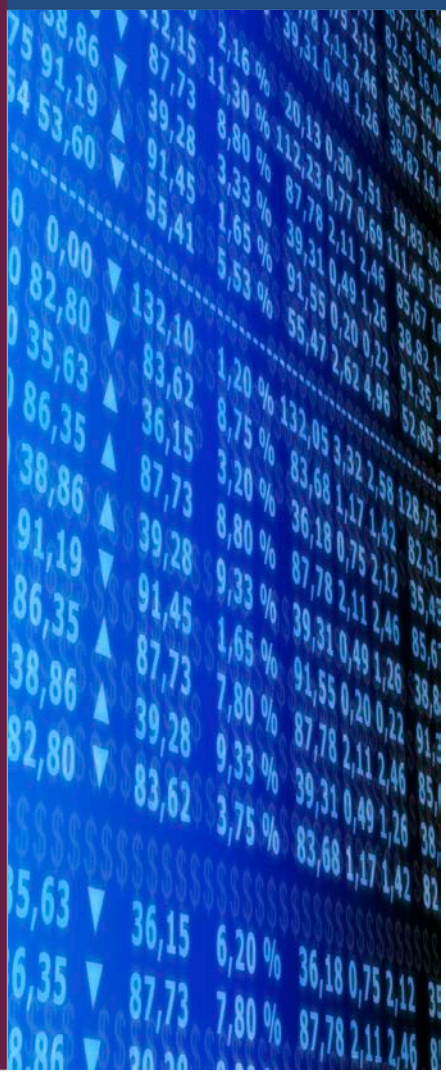
WORLD ENERGY COUNCIL
CONSEIL MONDIAL DE L'ÉNERGIE
For sustainable energy.

World Energy Perspective

Catalysing the low-carbon economy

WORLD ENERGY COUNCIL
CONSEIL MONDIAL DE L'ÉNERGIE



HTS 8482 Ball or roller bearings, and parts thereof

HTS 8482.10 Ball bearings

HTS 8482.20 Tapered roller bearings

HTS 8482.20.0020 Cup and cone assemblies entered as a set

HTS 8482.20.0020 Wheel hub units:

HTS 8482.20.0020 Flanged

HTS 8482.20.0030 Other

HTS 8482.20.0040 With cups having an outside diameter not exceeding 102 mm

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HTS 8482.30 Spherical roller bearings

HTS 8482.40 Needle roller bearings

HTS 8482.50 Other cylindrical roller bearings

HTS 8482.80 Other, including combined ball/roller bearings

8482.80.0020 Combined ball and spherical roller bearings

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Contents

1. Introduction

Sustainable energy is not only an opportunity to transform societies and grow economies, but also a necessity - a prerequisite to meet growing energy demand and reduce the carbon footprint. That is why it is so important to balance what the World Energy Council defines as the 'energy trilemma', a 21st century policy framework grounded in three critical elements that involve energy that is (1) secure; (2) affordable; and (3) environmentally sensitive.

Balancing the three core dimensions of the energy trilemma is a strong basis for prosperity and competitiveness of individual countries. Secure energy is critical to fuelling economic growth. Energy must be accessible and affordable at all levels of society to ensure social stability. The impact of energy production and energy use on the environment needs to be minimised in order to combat climate change as well as local air and water pollution and its implications.

Addressing the energy trilemma presents extraordinary environmental, social, and economic challenges requiring national and international action by not only governments, but also the private sector and civil society. Robust and enabling environments will be required toward these ends, including appropriate technology mechanisms and a global trade and investment regime that encourages and leverages investment, innovation, and technology uptake.

Existing and new technologies are needed to meet post-2015 climate and development goals and to do so at the lowest possible economic cost.

The World Energy Council's 2013 Scenarios highlighted that without these robust and enabling environments electricity generation from renewable energy sources may grow slower and the global economy will be challenged to meet the 450ppm target. The degree to which low-GHG technologies will be used will be decisive in mitigating climate change.[1]

As the world economy and population grow, global energy demand is predicted to increase and even double by 2050 (see Figure 1). To keep pace with this demand, cumulative investment requirements in electricity generation alone will be between US$19.3trn[2] and US$25.7trn between now and 2050.[3] Looking at the broader energy infrastructure, an estimated cumulative investment of US$40.2trn is required across the energy infrastructure supply chain over the period 2014 to 2035 with an additional US$8trn investment needed in energy efficiency. These investment requirements are

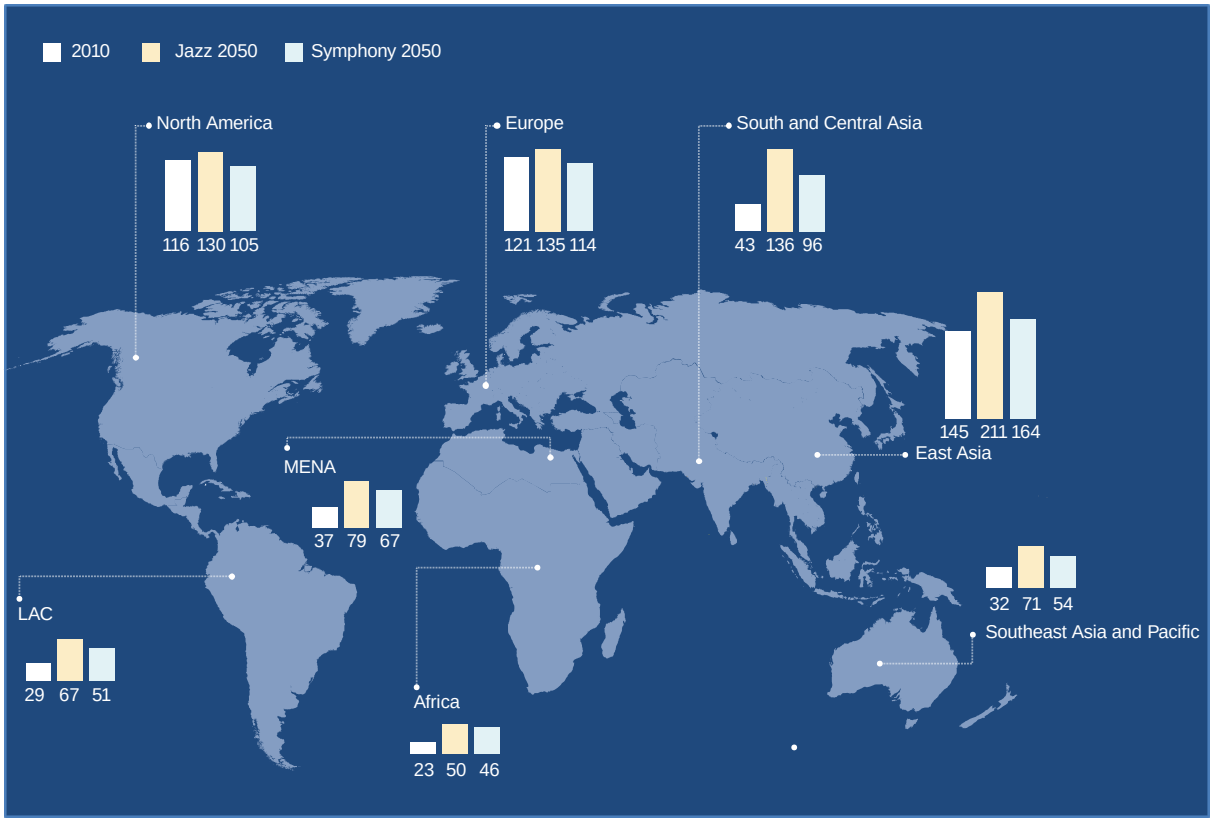
[1] World Energy Council, 2013: World Energy Scenarios: Composing energy futures to 2050; The lower number refers to the Council's 'Symphony' scenario, which focuses on achieving environmental sustainability through internationally coordinated policies and practices, while the higher number reflects the Council's 'Jazz' scenario, which focuses on energy equity with priority given to achieving individual access and affordability of energy through economic growth.
[2] This publication uses the short scale version of a trillion, i.e. one trillion means one thousand billion.
[3] World Energy Council, 2013: World Energy Scenarios: Composing energy futures to 2050

likely to rise by a further 10% to a total of US$53trn in cumulative investment by 2035 if the goal is set to a 2°C emissions path (a target to limit the average global temperature increases and the resulting climate change).[4]

Figure 1

Total primary energy supply (EJ, equal to consumption)

Source: World Energy Scenarios, 2013: Composing energy futures to 2050



[4] International Energy Agency (IEA), 2014: World Energy Investment Outlook; The 2°C scenario would require a doubling of investments in low-GHG technologies and energy efficiency.

2. Trade and the energy trilemma

Many countries struggle to balance the three competing dimensions of the energy trilemma and most policy decisions have to strike compromises between these objectives. For instance, in many countries, using domestic coal for power provides energy security at low cost, but at an environmental price. There are a few measures that help achieve all three. One is energy efficiency. Another is promoting trade in environmental goods and services.

Today, starting a business to supply electricity from renewable energy such as wind and solar is neither an easy nor a straight forward endeavour. First of all, there is the competition with fossil-fuelled power plants, technologies that are often operating at a huge scale, with low cost fuels, a century of operating experience and investors generally more comfortable to invest in the asset class. Secondly, there is the 'policy hangover' caused by sharp reversals on subsidy schemes, the small scale of projects, the lack of historic data and so on, which often makes it difficult to get investment-grade ratings. And lastly, there is the actual cost of renewable technologies, which are intermittent and have geographical constraints as they are often deployed in areas that are not connected to the existing grid. To make the business viable, every cent of cost and every kilowatt of output matters. This requires an incredible amount of creativity to squeeze out cost and promote quality. It also requires a capable team, good sites, reliable equipment and logistics.

The World Energy Council believes, first and foremost, that eliminating government imposed barriers to trade in environmental goods and services, thereby reducing their cost and spurring their utilisation, is a central means of contributing to international GHG reduction objectives, increasing energy access in developing and emerging economies, reducing the cost of technology and energy itself, and enhancing energy security.

The majority of governments have targets for increasing the share of renewable energy, reducing GHG emissions or increasing energy efficiency. Yet at the same time they are taxing all clean energy equipment that crosses their national borders. Those tariffs add to the cost challenge and make it harder, and in some instances impossible, to deliver renewable energy. Tariffs not only raise the cost of any project that uses imported products, they also drive up the cost of production by making it harder to achieve scale, and ultimately, by reducing the size of a potential renewable market, they undermine incentives for innovation in the clean energy space.

3. Recent developments

Global trade in environmental goods is estimated to be around US$1 trillion annually, and growing quickly. Globally, trade in environmental goods more than doubled from 2001 to 2007, and exports by developing countries rose as fast as those by developed economies.[5]

The importance of reducing or eliminating tariff and non-tariff barriers to environmental goods was recognized in the Doha WTO Ministerial Declaration of 2001.[6] Several G8 declarations have also endorsed this approach; for example, at the 2008 G8 Summit in Hokkaido, Japan, leaders called for the lowering of tariffs and other barriers to environmentally-friendly goods and services. With the Doha Round of trade negotiations largely inactive since 2009/2010, countries have turned to bilateral and regional free trade agreements.

The Asia Pacific Economic Partnership (APEC) acted first to create a trade programme designed to facilitate environmentally-friendly projects. In fact, at its leaders meeting in 2012, APEC nations committed to reduce and cap their tariffs on 54 environmentally-friendly products at 5%. Over half of these items are energy-related.[7] This action by APEC members, which represents 54% of world GDP and 44% of global trade, is a tangible international endorsement of the principle that trade liberalisation can contribute simultaneously to economic growth and to environmental sustainability.

It is important to note that the APEC decision deals only with tariffs on products and does not address non-tariff barriers, barriers to investment, or barriers to services trade. Furthermore, the APEC decision naturally applies only to 21 APEC members, not to all 159 countries of the WTO. Finally, APEC members undertake their commitments on an honour system. Unlike the WTO and most free trade agreements, there is no APEC process to formally 'bind' tariffs at the agreed level and no dispute settlement process should an APEC member later raise its tariffs above 5%.

Even though it is limited, the APEC's action is significant in setting a precedent. In January 2014 14 WTO members, which together account for 86% of global environmental goods trade[8], came together in Davos and announced their commitment to explore opportunities in the WTO to build on the APEC's ground-

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[5] United Nations Environment Programme, 2013: Green economy and trade trends, challenges and opportunities
[6] http://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_e.htm
[7] The complete list can be accessed at http://www.apec.org/Meeting-Papers/Leaders-Declarations/2012/2012_aelm/2012_aelm_annexC.aspx
[8] International Centre for Trade and Sustainable Development, 2014: "Green goods" trade initiative kicks off in Davos, 28 January 2014

breaking commitment to reduce tariffs by the end of 2015. Representatives of Australia, Canada, China, Costa Rica, the European Union, Hong Kong (China), Japan, Korea, New Zealand, Norway, Singapore, Switzerland, Chinese Taipei, and the United States pledged "to work together, and with other WTO Members similarly committed to liberalisation, to begin preparing for negotiations in order to advance this shared goal" of eliminating their tariffs on a set of environmental goods.

It was noted, that work would build on the APEC list of 54 environmental goods and that a broad range of additional products would be explored. Signatories of the Davos joint statement "anticipate a structure for an environmental goods agreement that would reinforce the rules- based multilateral trading system and benefit all WTO Members, including by involving all major traders and applying the principle of Most Favoured Nation. Such an agreement would take effect once a critical mass of WTO Members participates." Subsequently, in July 2014, the fourteen nations which made the Davos announcement connected in Geneva, Switzerland, to formally launch negotiations on an Environmental Goods Agreement.[9]

The elimination of tariffs on environmental goods matters. It makes it easier to have a greater total energy supply than under the status quo. It reduces costs of energy. And it promotes projects that reduce emissions. In short, tariff elimination positively impacts all three aspects of the energy trilemma. Moreover, it reduces the cost of clean energy technology, increases deployment and enables the development of industries in the countries that eliminate their tariffs.

Taking all of these initiatives a step further could occur in a number of ways. For instance through coverage of non-tariff barriers, coverage of services, and the addition of more countries participating. All are admirable goals, but each expansion of scope adds complexity to the process. The APEC agreement was possible because the product list was limited, the agreement only covered tariffs in the first instance, and tariffs were not eliminated, but capped at 5%. The agreement was not perfect, but it was achieved and helped inspire the current negotiation in the WTO, which could potentially go much farther. It is important for these plurilateral negotiations to achieve another tangible step in the right direction in the form of the first environmental goods tariff agreement.

[9] In the meantime, other WTO members have reportedly shown an interest in joining the initiative, including Israel, Turkey, Peru, and Chile.

4. Proposed list of goods for inclusion under an environmental goods tariff agreement

The Council's goal is to promote more international cooperation in the energy sector. That involves bringing the energy sector into more trade liberalising agreements as part of finding cooperative solutions to the most serious challenges our world faces.

Without robust and enabling policy environments, including appropriate technology mechanisms and a global trade and investment regime that encourages and leverages investment, innovation, and technology uptake, post-2015 climate and development goals may not be met.

Building on the World Energy Council's 2010 proposed list of goods for inclusion under an environmental goods agreement and incorporating the energy-related environmental goods included in the 2012 APEC list, the Council recommends the consideration of the following list of products by their harmonised system classification (HTS) numbers on which tariffs and other trade barriers should be eliminated. For the sake of completeness, all energy-related environmental goods included by APEC in 2012 are listed and highlighted accordingly (grey).[10]

The 112 products are presented in 5 categories, and some of the products may be included in several categories. To identify these goods an abbreviation was added next to the HST code in superscript.

1. Energy efficiency (EE)
2. Renewable energy: Hydro (H); Solar (S); Wind (W)
3. Natural gas (NG)
4. Carbon capture and storage (CCS)
5. Nuclear (N)

[10] The 2012 APEC list included 54 environmental goods. Over half of these goods were identified as energy-related and are included in the World Energy Council's list of recommended products where appropriate.

In selecting items, the World Energy Council team applied the three components of the energy trilemma outlined above. In short, these items involve furthering energy and energy delivery that is (1) secure; (2) affordable; and (3) environmentally sensitive. Moreover, it considered the following:

> ***"Scenarios that are likely to maintain warming at below 2°C include more rapid improvements in energy efficiency and a tripling to nearly a quadrupling of the share of zero- and low-GHG energy supply from renewable energy, nuclear energy and fossil energy with carbon dioxide capture and storage (CCS), or bioenergy with CCS (BECCS) by the year 2050."***[11]

The list is intended to be illustrative, not exhaustive, and is independent of other proposals.

Energy efficiency

> ***"Energy efficiency is a 'key mitigation strategy' in keeping global carbon emissions within a safe range through the end of the century." (IPCC, 2014)***

Table 1

Proposed list of goods: energy efficiency (41 goods)

Source: World Energy Council analysis

HTS	Product	Description	Explanation
7309.00[C]	Pipelines, tanks, reservoirs and containers	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat insulated, but not fitted with mechanical or thermal equipment	Necessary for energy efficiency processes and value chains
7310.00[C]	Pipelines, tanks, reservoirs and containers	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat insulated, but not fitted with mechanical or thermal equipment	Necessary for energy efficiency processes and value chains
7311.00[C]	Pipelines, tanks, reservoirs and containers	Containers for compressed or liquefied gas, of iron or steel	Necessary for energy efficiency processes and value chains

[11] Intergovernmental Panel on Climate Change (IPCC), 2014: Fifth Assessment Report (Synthesis Report)

HTS	Product	Description	Explanation
7611.00[C]	Pipelines, tanks, reservoirs and containers	Aluminium reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	Necessary for energy efficiency processes and value chains
7613.00[C]	Pipelines, tanks, reservoirs and containers	Aluminium containers for compressed or liquefied gas.	Necessary for energy efficiency processes and value chains
8402.00	Generators, pumps, elevators, safety and relief values	Steam or other vapour generating boilers (other than central heating hot water boilers capable also of producing low pressure steam); super-heated water boilers	Necessary for energy efficiency processes and value chains
8404.00	Generators, pumps, elevators, safety and relief values	Auxiliary plant for use with boilers of heading 84.02 or 84.03 (for example, economisers, super-heaters, soot removers, gas recoverers); condensers for steam or other vapour power units	Necessary for energy efficiency processes and value chains
8405.00	Generators, pumps, elevators, safety and relief values	Producer gas or water gas generators, with or without their purifiers; acetylene gas generators and similar water process gas generators, with or without their purifiers	Necessary for energy efficiency processes and value chains
8413.00[C, N]	Pumps, elevators, safety and relief valves	Pumps for liquids, whether or not fitted with a measuring device; liquids elevators	Necessary for energy efficiency processes and value chains
8414.00[C, N]	Pumps, elevators, safety and relief valves	Air or vacuum pumps, air or other gas compressors and fans; ventilating or recycling hoods incorporating a fan, whether or not fitted with filters	Necessary for energy efficiency processes and value chains
8416.00[C]	Pumps, elevators, safety and relief valves	Furnace burners for liquid fuel, for pulverised solid fuel or for gas; mechanical stokers, including their mechanical grates, mechanical ash dischargers and similar appliances	Necessary for energy efficiency processes and value chains
8419.00[C]	Water demineralisation equipment	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.	Necessary for energy efficiency processes and value chains

HTS	Product	Description	Explanation
8421.00[N]	Water demineralisation equipment	Centrifuges, including centrifugal dryers; filtering or purifying machinery and apparatus, for liquids and gases	Necessary for energy efficiency processes and value chains
8474.00[C]	Pumps, elevators, safety and relief valves	Machinery for sorting, screening, separating, washing, crushing, grinding, mixing or kneading earth, stone, ores or other mineral substances, in solid (including powder or paste) form; machinery for agglomerating, shaping or moulding solid mineral fuels, ceramic paste, unhardened cements, plastering materials or other mineral products in powder or paste form; machines for forming foundry moulds of sand	Necessary for energy efficiency processes and value chains
8481.00[C]	Pumps, elevators, safety and relief valves	Taps, cocks, valves and similar appliances for pipes, boiler shells, tanks, vats or the like, including pressure-reducing valves and thermostatically controlled valves	Necessary for energy efficiency processes and value chains
8504.21	High Voltage Converters and Flexible AC Transmission Systems (FACTS and control devices)	Electrical transformers, static converters (for example, rectifiers) and inductors having a power handling capacity not exceeding 650 kVA	FACTS are necessary for control operation in large and complex Distribution Networks. HVDC interconnections avoid building new power plants and helping to increase the power system stability.
8504.22	High Voltage Converters and Flexible AC Transmission Systems (FACTS and control devices)	Electrical transformers, static converters (for example, rectifiers) and inductors having a power handling capacity exceeding 650 kVA but not exceeding 10,000 kVA	FACTS are necessary for control operation in large and complex Distribution Networks. HVDC interconnections avoid building new power plants and helping to increase the power system stability.
8504.23	High Voltage Converters and Flexible AC Transmission Systems (FACTS and control devices)	Electrical transformers, static converters (for example, rectifiers) and inductors having a power handling capacity exceeding 10,000 kVA	FACTS are necessary for control operation in large and complex Distribution Networks. HVDC interconnections avoid building new power plants and helping to increase the power system stability.
8504.31	High Voltage Converters and Flexible AC Transmission Systems (FACTS and control devices)	Electrical transformers, static converters (for example, rectifiers) and inductors having a power handling capacity not exceeding 1 kVA	FACTS are necessary for control operation in large and complex Distribution Networks. HVDC interconnections avoid building new power plants and helping to increase the power system stability.
8504.32	High Voltage Converters and Flexible AC Transmission Systems (FACTS and control devices)	Electrical transformers, static converters (for example, rectifiers) and inductors having a power handling capacity exceeding 1 kVA but not exceeding 16 kVA	FACTS are necessary for control operation in large and complex Distribution Networks. HVDC interconnections avoid building new power plants and helping to increase the power system stability.

HTS	Product	Description	Explanation
8504.33	High Voltage Converters and Flexible AC Transmission Systems (FACTS and control devices)	Electrical transformers, static converters (for example, rectifiers) and inductors having a power handling capacity exceeding 16 kVA but not exceeding 500 kVA	FACTS are necessary for control operation in large and complex Distribution Networks. HVDC interconnections avoid building new power plants and helping to increase the power system stability.
8504.34	High Voltage Converters and Flexible AC Transmission Systems (FACTS and control devices)	Electrical transformers, static converters (for example, rectifiers) and inductors having a power handling capacity exceeding 500 kVA	FACTS are necessary for control operation in large and complex Distribution Networks. HVDC interconnections avoid building new power plants and helping to increase the power system stability.
8504.40[S, W]	High Voltage Converters and Flexible AC Transmission Systems (FACTS and control devices)	Static converters	FACTS are necessary for control operation in large and complex Distribution Networks. HVDC interconnections avoid building new power plants and helping to increase the power system stability.
8504.90	High Voltage Converters and Flexible AC Transmission Systems (FACTS and control devices)	Parts for electrical transformers, static converters and inductors	Used to convert DC current from renewable energy generating sets into conventional AC electricity
8506.80	Advanced batteries	Other primary cells and primary batteries	Storage devices allow shifting any part of a load
8535.00	High speed protection relays and substation automatisation	Electrical apparatus for switching or protecting electrical circuits, or for making connections to or in electrical circuits (for example, switches, fuses, lightning arresters, voltage limiters, surge suppressors, plugs, junction boxes), for a voltage exceeding 1,000 volts.	Necessary to provide more timely and accurate information to the control centres to eliminate congestion points in the grid
8536.00	High speed protection relays and substation automatisation	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.	Necessary to provide more timely and accurate information to the control centres to eliminate congestion points in the grid
8537.00[H]	Electronic control equipment	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus of heading 85.35 or 85.36, for electric control or the distribution of electricity, including those incorporating instruments or apparatus of Chapter 90, and numerical control apparatus, other than switching apparatus of heading 85.17	For EE in power distribution networks, high speed protection relays & substation automatisation are necessary to provide more timely and accurate information to the control centres to eliminate congestion points in the grid. In EE plant-level consumption, SCADA advanced techniques can assist the operators to prevent major blackouts.

HTS	Product	Description	Explanation
8539.31	Lighting	Compact fluorescent lamps	Reduces energy consumption
8543.70	Lighting	LED lamps	Reduces energy consumption
9015.00[C]	Surveying and measuring instrument	Surveying (including photo-grammatical surveying), hydrographic, oceanographic, hydrological, meteorological or geophysical instruments and appliances, excluding compasses; rangefinders	Necessary for energy efficiency processes and value chains
9026.00[C]	Surveying and measuring instrument	Instruments and apparatus for measuring or checking the flow, level, pressure or other variables of liquids or gases (for example, flow meters, level gauges, manometers, heat meters)	Necessary for energy efficiency processes and value chains
9028.00[C]	Surveying and measuring instrument	Gas, liquid or electricity supply or production meters, including calibrating meters therefor	Necessary for energy efficiency processes and value chains
9028.10	Surveying and measuring instrument	Gas meters	Necessary for energy efficiency processes and value chains
9028.20	Surveying and measuring instrument	Liquid meters	Necessary for energy efficiency processes and value chains
9028.30	Advanced meters for distributed generation	Electricity meters	Necessary for controlling distributed generation and for enabling demand response
9030.20	Advanced Sensors for Predictive Maintenance	Oscilloscopes and oscillographs; other instruments or apparatus for measuring or checking voltage, current, resistance or power	Necessary to determine the life remaining in the transmission and distribution equipment and determine maintenance needs
9032.00[C]	Surveying and measuring instrument	Automatic regulating or controlling instruments and apparatus	Necessary for energy efficiency processes and value chains
9032.89[W]	Surveying and measuring instruments	Automatic regulating or controlling instruments and apparatus	Includes other automatic voltage and current regulators which have renewable energy and smart grid applications, process control instruments and apparatus for temperature, pressure, flow and level, and regulators for humidity applications that help increase energy efficiency
9032.90	Surveying and measuring instruments	Parts and accessories for nominated articles of subheading 9032	Parts for the automatic regulating and control system instruments classified in 9032 and described
9033.00	Advanced meters for distributed generation	Parts and accessories for machines appliances, instruments or apparatus of chapter 90	Necessary for controlling distributed generation and for enabling demand response

Renewable Energy

"Renewable energy (RE) sources have significant potential for reducing GHG emissions, and are becoming more competitive." (IPCC, 2014)

Table 2

Proposed list of goods: hydro (5 goods)

Source: World Energy Council analysis

HTS	Product	Description	Explanation
8410.11	Turbine generators	Hydraulic turbines of a power not exceeding 1,000 kW	Produces electricity from water
8410.12	Turbine generators	Hydraulic turbines of a power exceeding 1,000 kW but not exceeding 10,000 kW	Produces electricity from water
8410.13	Turbine generators	Hydraulic turbines of a power exceeding 10,000 kW	Produces electricity from water
8410.90	Single-phase voltage regulators, three-phase voltage regulators, generator voltage regulators (static excitation), speed governors	Parts of hydraulic turbines, including regulators	Necessary for hydro power generation
8537.00[EE]	Electronic control equipment	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus of heading 85.35 or 85.36, for electric control or the distribution of electricity, including those incorporating instruments or apparatus of Chapter 90, and numerical control apparatus, other than switching apparatus of heading 85.17	Includes the ALCID-SICC control system, which is necessary for hydro renewable power generation.

Table 3

Proposed list of goods: solar (18 goods)

Source: World Energy Council analysis

HTS	Product	Description	Explanation
8402.90[N]	Water boiler parts	Parts of steam or other vapour generating boilers (other than central heating hot water boilers capable also of producing low pressure steam); super-heated water boilers	Generate steam for solar thermal power generation.
8404.10[N]	Heat exchangers and air coolers	Auxiliary plant for use with boilers of heading 84.02 or 84.03	For solar renewable energy generation, heat exchange units transfer solar energy absorbed in solar collectors to the liquid or air used to heat water; auxiliary plants generate steam for solar thermal power generation.

HTS	Product	Description	Explanation
8404.90[C, N]	Heat exchangers and air coolers	Parts	For solar renewable energy generation, heat exchange units transfer solar energy absorbed in solar collectors to the liquid or air used to heat water; auxiliary plants generate steam for solar thermal power generation.
8406.81[N, NG]	Steam turbine	Steam and other vapour turbines (except marine propulsion), of an output exceeding 40 MW, not elsewhere specified or included	In solar renewable energy generation, these turbines generate electricity from steam from high temperature solar thermal devices.
8406.82[N, NG]	Steam turbine	Steam and other vapour turbines (except marine propulsion), of an output not exceeding 40 MW, not elsewhere specified or included	In solar renewable energy generation, these turbines generate electricity from steam from high temperature solar thermal devices.
8419.50[C]	Heat exchangers and air coolers	Brazed aluminium plate-fin heat exchangers	For solar renewable energy generation, heat exchange units transfer solar energy absorbed in solar collectors to the liquid or air used to heat water; auxiliary plants generate steam for solar thermal power generation.
8419.90[C]	Heat exchangers and air coolers	Parts of apparatus for treatment of materials by temperature	Parts used in maintenance and repair of solar water heaters
8479.89	Solar racking structure	Machines and mechanical appliances having individual functions, not specified or included elsewhere in this chapter, parts thereof: other machines and mechanical appliances: other	Used for mounting solar panels onto surfaces.
8504.40[EE,W]	High Voltage Converters and Flexible AC Transmission Systems (FACTS and control devices)	Static converters	Inverters in solar renewable energy generation are used to convert direct current (DC) power into alternating current (AC) power for photovoltaic solar power generation.
8507.00[W]	Large energy storage batteries	Electric accumulators, including separators therefor, whether or not rectangular (including square)	Enables use of renewables on a power grid
8537.10[W]	Electronic control equipment	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus of heading 8535 or 8536, for electric control or the distribution of electricity, including those incorporating instruments or apparatus of chapter 90, and numerical control apparatus, other than switching apparatus of heading 8517, for a voltage not exceeding 1,000 V	In solar renewable energy generation, the photovoltaic system controller is used to control photovoltaic output devices.

HTS	Product	Description	Explanation
8537.20	Electronic control equipment	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus of heading 8535 or 8536, for electric control or the distribution of electricity, including those incorporating instruments or apparatus of chapter 90, and numerical control apparatus, other than switching apparatus of heading 8517, for a voltage exceeding 1,000 V	In solar renewable energy generation, the photovoltaic system controller is used to control photovoltaic output devices.
8541.40	Solar cells	Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels.	Used for converting solar energy into electrical energy.
9001.90	Mirror	Non-glass mirrors	Specifically used for solar concentrator systems, the mirror concentrates solar radiation for converting into high temperature steam to generate thermal energy
9002.90	Mirror	Glass mirrors	Specifically used for solar concentrator systems, the mirror concentrates solar radiation for converting into high temperature steam to generate thermal energy
9013.80	Solar heliostats	Optical devices, appliances and instruments	Heliostats orient mirrors in concentrated solar power systems to reflect sunlight on to a CSP receiver.
9013.90	Solar heliostats	Part and accessories for optical devices, appliances and instruments	Heliostats orient mirrors in concentrated solar power systems to reflect sunlight on to a CSP receiver.

Table 4

Proposed list of goods: wind (22 goods)

Source: World Energy Council analysis

HTS	Product	Description	Explanation
7308.20	Tower	Towers and lattice masts	Physically supports the wind power nacelle
8412.90	Wind turbine parts	Parts of other engines and motors	Wind turbine blade (which capture the wind that is converted into electricity), hub (holds the wind turbine blades in place).
8482.10	Bearings	Ball bearings	Ball or roller bearings
8482.20	Bearings	Tapered roller bearings	Ball or roller bearings
8482.30	Bearings	Spherical roller bearings	Ball or roller bearings
8482.40	Bearings	Needle roller bearings	Ball or roller bearings
8482.50	Bearings	Other cylindrical roller bearings	Ball or roller bearings
8482.80	Bearings	Other ball or roller bearings	Ball or roller bearings

HTS	Product	Description	Explanation
8483.40	Gear box	Gears and gearing, other than toothed wheels, chain sprockets and other transmission elements presented separately; ball or roller screws; gear boxes and other speed changers, including torque converters	Controls the rotation speeds required to produce wind-powered electricity
8483.60	Clutches; universal joints	Clutches and shaft couplings (including universal joints)	Specifically used for wind turbines
8501.61[N, NG]	Generators and generator sets	AC Generators (alternators) of an output not exceeding 75 kVA	Wind turbine generators convert mechanical energy to electrical energy.
8501.62[N, NG]	Generators and generator sets	AC Generators (alternators) of an output exceeding 75kVa but not exceeding 375 kVA	Wind turbine generators convert mechanical energy to electrical energy.
8501.63[N, NG]	Generators and generator sets	AC Generators (alternators) of an output exceeding 375kVa but not exceeding 750 kVA	Wind turbine generators convert mechanical energy to electrical energy.
8501.64[N, NG]	Generators and generator sets	AC Generators (alternators) of an output exceeding 750 kVA	Wind turbine generators convert mechanical energy to electrical energy.
8502.31	Gear box with generator	Other electric generating sets, wind-powered	Houses the gear box, low- and high-speed shafts, generator, controller, and brake, which together convert wind energy into electrical energy.
8503.00	Nacelle / electric generating sets	"Parts suitable for use solely or principally with the machines of heading 8502	Houses the gear box, low- and high-speed shafts, generator, controller, and brake, which together convert wind energy into electrical energy.
8504.40[S]	High Voltage Converters and Flexible AC Transmission Systems (FACTS and control devices)	Static converters	Static converters in wind renewable energy generation are used to convert electrical energy generated by wind power in order to adapt it for use.
8507.00[S]	Large energy storage batteries	Electric accumulators, including separators therefor, whether or not rectangular (including square)	Enables use of renewables on a power grid
8537.10[S]	Electronic control equipment	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus of heading 8535 or 8536, for electric control or the distribution of electricity, including those incorporating instruments or apparatus of chapter 90, and numerical control apparatus, other than switching apparatus of heading 8517, for a voltage not exceeding 1,000 V	In wind renewable energy generation, the ground control system is used to control and monitor the turbine.

HTS	Product	Description	Explanation
8537.20	Electronic control equipment	Boards, panels, consoles, desks, cabinets and other bases, equipped with two or more apparatus of heading 8535 or 8536, for electric control or the distribution of electricity, including those incorporating instruments or apparatus of chapter 90, and numerical control apparatus, other than switching apparatus of heading 8517, for a voltage exceeding 1,000 V	In wind renewable energy generation, the ground control system is used to control and monitor the turbine.
9015.80	Meteorological equipment	Hydrological, oceanographic, meteorological equipment	Meteorological equipment for measurement of weather conditions on the wind sites is vital for the optimal functioning of a wind turbine.
9032.89[EE]	Surveying and measuring instruments	Automatic regulating or controlling instruments and apparatus	Includes other automatic voltage and current regulators which have renewable energy and smart grid applications, process control instruments and apparatus for temperature, pressure, flow and level, and regulators for humidity applications that help increase energy efficiency.

Natural gas

"Replacing a higher-carbon fuel with a lower-carbon alternative can reduce overall emissions. For example, shifting from a current world-average coal-fired power plant to a modern natural gas combined cycle (NGCC) unit can halve emissions, provided that fugitive methane emissions are controlled." (IPCC, 2014)

Table 5

Proposed list of goods: natural gas (15 goods)

Source: World Energy Council analysis

HTS	Product	Description	Explanation
8402.19	Steam generators; heat exchangers	Vapour generating boilers, incl. hybrid boilers (excl. central heating hot water boilers capable also of producing low pressure steam)	For natural gas power generation, hear recovery steam generators create steam for use in a steam turbine in combined-cycle operations.
8404.20[C, N]	Heat exchangers and air coolers	Condensers for steam or other vapour power units	For solar renewable energy generation, heat exchange units transfer solar energy absorbed in solar collectors to the liquid or air used to heat water; auxiliary plants generate steam for solar thermal power generation.

HTS	Product	Description	Explanation
8406.81[N, S]	Steam turbine	Steam and other vapour turbines (except marine propulsion), of an output exceeding 40 MW, not elsewhere specified or included	In natural gas power generation, steam turbines turn exhaust heat from gas engines or gas turbines into usable energy.
8406.82[N, S]	Steam turbine	Steam and other vapour turbines (except marine propulsion), of an output not exceeding 40 MW, not elsewhere specified or included	In natural gas power generation, steam turbines turn exhaust heat from gas engines or gas turbines into usable energy.
8406.90[N]	Steam turbine	Parts of steam and other vapour turbines	In natural gas power generation, steam turbines turn exhaust heat from gas engines or gas turbines into usable energy.
8407.90	Reciprocating engines	Spark-ignition reciprocating or rotary internal combustion piston engines	For natural gas power generation, reciprocating engines combust natural gas into mechanical motion for electrical generation.
8409.91	Reciprocating engines	Parts suitable for use solely or principally with the engines of heading 8407 or 8408—Other than for aircraft engines—Suitable for use solely or principally with spark-ignition internal combustion piston engines (including rotary engines)	For natural gas power generation, reciprocating engines combust natural gas into mechanical motion for electrical generation.
8411.81	Gas turbines	Other gas turbines of a power not exceeding 5,000 kW	Combusts natural gas into mechanical motion for electrical generation.
8411.82	Gas turbines	Other gas turbines of a power exceeding 5,000 kW	Combusts natural gas into mechanical motion for electrical generation.
8411.99	Gas turbines	Parts of gas turbines (including control panels)	Combusts natural gas into mechanical motion for electrical generation.
8501.61[N, W]	Generators and generator sets	AC Generators (alternators) of an output not exceeding 75 kVA	For natural gas power generation, generators turn rotation of turbines/engines into electricity.
8501.62[N, W]	Generators and generator sets	AC Generators (alternators) of an output exceeding 75kVa but not exceeding 375 kVA	For natural gas power generation, generators turn rotation of turbines/engines into electricity.
8501.63[N, W]	Generators and generator sets	AC Generators (alternators) of an output exceeding 375kVa but not exceeding 750 kVA	For natural gas power generation, generators turn rotation of turbines/engines into electricity.
8501.64[N, W]	Generators and generator sets	AC Generators (alternators) of an output exceeding 750 kVA	For natural gas power generation, generators turn rotation of turbines/engines into electricity.
8502.39	Generators and generator sets	Generating sets powered by gas turbines	For natural gas power generation, generators turn rotation of turbines/engines into electricity.

Carbon capture and storage

"Carbon capture and storage technologies are capable of significantly reducing the CO2 emissions of fossil fuel-fired power plants." (IPCC, 2014)

Table 6

Proposed list of goods: carbon capture and storage (23 goods)

Source: World Energy Council analysis

HTS	Product	Description	Explanation
7309.00[EE]	Pipelines, tanks, reservoirs and containers	Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat insulated, but not fitted with mechanical or thermal equipment	Necessary for CCS processes and value chains
7310.00[EE]	Pipelines, tanks, reservoirs and containers	Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat insulated, but not fitted with mechanical or thermal equipment	Necessary for CCS processes and value chains
7311.00[EE]	Pipelines, tanks, reservoirs and containers	Containers for compressed or liquefied gas, of iron or steel	Necessary for CCS processes and value chains
7611.00[EE]	Pipelines, tanks, reservoirs and containers	Aluminium reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	Necessary for CCS processes and value chains
7613.00[EE]	Pipelines, tanks, reservoirs and containers	Aluminium containers for compressed or liquefied gas.	Necessary for CCS processes and value chains
8404.10[N]	Heat exchangers and air coolers	Auxiliary plant for use with boilers of heading 84.02 or 84.03	Critical for generating power efficiently in CCS plants.
8404.20[N, NG]	Heat exchangers and air coolers	Condensers for steam or other vapour power units	Critical for generating power efficiently in CCS plants.
8404.90[N, S]	Heat exchangers and air coolers	Parts	Critical for generating power efficiently in CCS plants.
8413.00[EE, N]	Pumps, elevators, safety and relief valves	Pumps for liquids, whether or not fitted with a measuring device; liquids elevators.	Necessary for CCS processes and value chains
8414.00[EE, N]	Pumps, elevators, safety and relief valves	Air or vacuum pumps, air or other gas compressors and fans; ventilating or recycling hoods incorporating a fan, whether or not fitted with filters	Necessary for CCS processes and value chains

HTS	Product	Description	Explanation
8414.80	Gas compressor	Air or other gas compressors	Critical for CO2 capture and injection stages.
8414.90	Gas compressor	Parts of air or other gas compressors	Critical for CO2 capture and injection stages.
8416.00[EE]	Pumps, elevators, safety and relief valves	Furnace burners for liquid fuel, for pulverised solid fuel or for gas; mechanical stokers, including their mechanical grates, mechanical ash dischargers and similar appliances	Necessary for CCS processes and value chains
8419.50[S]	Heat exchangers and air coolers	Brazed aluminium plate-fin heat exchangers	Critical for generating power efficiently in CCS plants.
8419.60	Heat exchangers and air coolers	Machinery for liquefying air or other gases	Critical for generating power efficiently in CCS plants.
8419.89	Heat exchangers and air coolers	Other apparatus for treatment of materials by temperature	Critical for generating power efficiently in CCS plants.
8419.90[S]	Heat exchangers and air coolers	Parts of apparatus for treatment of materials by temperature	Critical for generating power efficiently in CCS plants.
8474.00[EE]	Pumps, elevators, safety and relief valves	Machinery for sorting, screening, separating, washing, crushing, grinding, mixing or kneading earth, stone, ores or other mineral substances, in solid (including powder or paste) form; machinery for agglomerating, shaping or moulding solid mineral fuels, ceramic paste, unhardened cements, plastering materials or other mineral products in powder or paste form; machines for forming foundry moulds of sand.	Necessary for CCS processes and value chains
8481.00[EE]	Pumps, elevators, safety and relief valves	Taps, cocks, valves and similar appliances for pipes, boiler shells, tanks, vats or the like, including pressure-reducing valves and thermostatically controlled valves.	Necessary for CCS processes and value chains
9015.00[EE]	Surveying and measuring instrument	Surveying (including photogrammetric surveying), hydrographic, oceanographic, hydrological, meteorological or geophysical instruments and appliances, excluding compasses; rangefinders	Necessary for CCS processes and value chains
9026.00[EE]	Surveying and measuring instrument	Instruments and apparatus for measuring or checking the flow, level, pressure or other variables of liquids or gases (for example, flow meters, level gauges, manometers, heat meters)	Necessary for CCS processes and value chains
9028.00[EE]	Surveying and measuring instrument	Gas, liquid or electricity supply or production meters, including calibrating meters therefor	Necessary for CCS processes and value chains
9032.00[EE]	Surveying and measuring instrument	Automatic regulating or controlling instruments and apparatus.	Necessary for CCS processes and value chains

Nuclear

"Nuclear energy could make an increasing contribution to a low-carbon energy supply." (IPCC, 2014)

Table 7

Proposed list of goods: nuclear (33 goods)

Source: World Energy Council analysis

HTS	Product	Description	Explanation
2612.10	Uranium	Uranium ores and concentrates	Fuel for nuclear power plants
2844.10	Uranium	Natural uranium and its compounds; alloys, dispersions (including cermet), ceramic products and mixtures containing natural	Fuel for nuclear power plants
2844.20	Uranium	Uranium enriched in U 235 and its compounds; plutonium and its compounds alloys, dispersions, including cermet, ceramic products and mixtures containing natural uranium enriched in U 235, plutonium or compounds of these products	Fuel for nuclear power plants
2844.30	Uranium	Uranium depleted in U 235 and its compounds; thorium and its compounds; alloys, dispersions (including cermet), ceramic products and mixtures containing uranium depleted in U 235, thorium or compounds of these products	Fuel for nuclear power plants
2844.40	Uranium	Radioactive elements and isotopes and compounds other than those	Fuel for nuclear power plants
2844.50	Uranium	Spent (irradiated) fuel elements (cartridges) of nuclear reactors	Fuel for nuclear power plants
8401.10	Nuclear reactors and parts of nuclear reactors	Nuclear reactors	Necessary for nuclear reactor operation
8401.20	Nuclear reactors and parts of nuclear reactors	Machinery and apparatus for isotopic separation and parts thereof	Necessary for nuclear reactor operation
8401.30	Nuclear reactors and parts of nuclear reactors	Fuel elements "cartridges", non-irradiated and parts thereof	Necessary for nuclear reactor operation
8401.40	Nuclear reactors and parts of nuclear reactors	Parts of nuclear reactors	Necessary for nuclear reactor operation
8402.11	Steam generators; heat exchangers	Water tube boilers with a steam production exceeding 45 t / hour	Big component of the nuclear island of a nuclear power plant
8402.12	Steam generators; heat exchangers	Water tube boilers with a steam production not exceeding 45 t per hour	Big component of the nuclear island of a nuclear power plant
8402.19	Steam generators; heat exchangers	Vapour generating boilers, incl. hybrid boilers (excl. central heating hot water boilers capable also of producing low pressure steam)	Big components of the nuclear island of a nuclear power plant

HTS	Product	Description	Explanation
8402.20	Steam generators; heat exchangers	Superheated water boilers	Big component of the nuclear island of a nuclear power plant
8402.90[S]	Water boiler parts	Parts of steam or other vapour generating boilers (other than central heating hot water boilers capable also of producing low pressure steam); super-heated water boilers	Big components of the nuclear island of a nuclear power plant
8404.10[C, S]	Heat exchangers and air coolers	Auxiliary plant for use with boilers of heading 84.02 or 84.03	Big components of the nuclear island of a nuclear power plant.
8404.20[C, NG]	Heat exchangers and air coolers	Condensers for steam or other vapour power units	Big components of the nuclear island of a nuclear power plant.
8404.90[C, S]	Heat exchangers and air coolers	Parts	Big components of the nuclear island of a nuclear power plant.
8406.10	Steam turbine	Steam and other vapour turbines for marine propulsion	In nuclear power generation, these turbines use steam to generate electricity.
8406.81[NG, S]	Steam turbine	Steam and other vapour turbines (except marine propulsion), of an output exceeding 40 MW, not elsewhere specified or included	In nuclear power generation, these turbines use steam to generate electricity.
8406.82[NG, S]	Steam turbine	Steam and other vapour turbines (except marine propulsion), of an output not exceeding 40 MW, not elsewhere specified or included	In nuclear power generation, these turbines use steam to generate electricity.
8406.90[NG]	Steam turbine	Parts of steam and other vapour turbines	In nuclear power generation, these turbines use steam to generate electricity.
8413.00[C, EE]	Pumps, elevators, safety and relief valves	Pumps for liquids, whether or not fitted with a measuring device; liquids elevators	For nuclear power generation, pumps are necessary for reactor operation and safety; moves coolant and other water.
8414.00[C, EE]	Pumps, elevators, safety and relief valves	Air or vacuum pumps, air or other gas compressors and fans; ventilating or recycling hoods incorporating a fan, whether or not fitted with filters	For nuclear power generation, pumps are necessary for reactor operation and safety; moves coolant and other water.
8419.00[EE]	Water demineralisation equipment	Machinery, plant or laboratory equipment, whether or not electrically heated (excluding furnaces, ovens and other equipment of heading 8514)	Necessary for power plant operation; provides usable water for reactor operation.
8421.00[EE]	Water demineralisation equipment	Centrifuges, including centrifugal dryers; filtering or purifying machinery and apparatus, for liquids and gases	Necessary for power plant operation; provides usable water for reactor operation
8425.00	Cranes, equipment for lifting / loading / unloading / extracting / handling nuclear fuel assemblies	Pulley tackle and hoists other than skip hoists; winches and capstans; jacks	Necessary for nuclear power plant operation

HTS	Product	Description	Explanation
8426.00	Cranes, equipment for lifting / loading / unloading / extracting / handling nuclear fuel assemblies	Ships' derricks; cranes, including cable cranes; mobile lifting frames, straddle carriers and works trucks fitted with a crane	Necessary for nuclear power plant operation
8427.00	Cranes, equipment for lifting / loading / unloading / extracting / handling nuclear fuel assemblies	Fork-lift trucks; other works trucks fitted with lifting or handling equipment	Necessary for nuclear power plant operation
8501.61[NG, W]	Generators and generator sets	AC Generators (alternators) of an output not exceeding 75 kVA	For nuclear power plant operation, generators create electricity from steam turbines; necessary for plant operation.
8501.62[NG, W]	Generators and generator sets	AC Generators (alternators) of an output exceeding 75kVa but not exceeding 375 kVA	For nuclear power plant operation, generators create electricity from steam turbines; necessary for plant operation.
8501.63[NG, W]	Generators and generator sets	AC Generators (alternators) of an output exceeding 375kVa but not exceeding 750 kVA	For nuclear power plant operation, generators create electricity from steam turbines; necessary for plant operation.
8501.64[NG, W]	Generators and generator sets	AC Generators (alternators) of an output exceeding 750 kVA	For nuclear power plant operation, generators create electricity from steam turbines; necessary for plant operation.

Appendix A: Project participation

The project team would like to thank the individuals who informed the project's approach, supplied information, provided ideas, and reviewed drafts. Their support and insights have made a major contribution to the development of the report.

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Appendix B: Principles on rules of trade and investment (extract, published in November 2011)

Agreed government measures for improving market access for energy-related environmental goods should be based on the following principles:

1. The international objective of securing reduction of GHG emissions will be aided through elimination of government imposed barriers to trade in Environmental Goods and Services.
2. GHG reduction through greater market access in energy-related environmental goods is impeded by unnecessarily high duties and therefore tariff rates on these goods should be substantially reduced and, where possible, eliminated entirely.
3. Reducing both tariffs and non-tariff market access barriers will lower the cost of new energy efficient technologies, thereby spurring their utilization and ultimately assisting in the realization of broader environmental goals for the world community at large.
4. Given the stalemate in the Doha Round, interested parties – governments and international organizations – should maintain the momentum on EGS outside the WTO framework. This effort should begin through informal talks among interested governments aimed at furthering the discussions and/or consensus on EGS achieved in the Doha Round.
5. This effort should begin as soon as possible. The starting point should be to agree on the list of energy products compiled by WEC in six areas: (1) power distribution and plants; (2) carbon capture and storage; (3) renewable energy forms; (4) nuclear power; (5) natural gas uses; and (6) flare gas reduction.
6. Energy and energy-related services are a growing and critical element in energy trade. The next step, therefore, should be to move on to the related areas of energy services and to reach an agreed energy services classification list.
7. The ultimate objective should be to reach consensus on the widest possible improvement of market access for both energy goods and services, through tariff reductions and/or elimination and other means, under either a multilateral or a plurilateral framework.
8. Such an agreement will narrow the cost differential between the more expensive, cleaner technologies and the more polluting, traditional sources of energy. It will help create economies of scale, further reducing sector-wide costs. It will lead to increased investment flows into high technology manufacturing and research in lower cost economies. It will assist developing countries in enhancing access to energy and move the global community one step further on a wider path to free trade in energy products and services.

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