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Clean technologies and the Survey of Environmental Goods and Services: A technical reference guide

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Clean technologies and the Survey of Environmental Goods and Services: A technical reference guide

Overview

This reference guide is intended for users of the Survey of Environmental Goods and Services (SEGS). The SEGS measures revenues, employment and exports from the provision of environmental and clean technology goods and services. This guide provides an overview of the goods, services, and technologies that fall within the Government of Canada clean technology priorities, as defined by the clean technology (cleantech) taxonomy, and which were used to develop content for the SEGS.

The Canadian clean technology taxonomy was developed by Natural Resources Canada in conjunction with partners at Innovation, Science and Economic Development Canada; Global Affairs Canada; Agriculture and Agri-Food Canada; Fisheries and Oceans Canada; Environment and Climate Change Canada; and Statistics Canada.

About this product

The taxonomy detailed in the following tables represents the suite of products that are considered to be clean technologies, and which are either currently included or being considered for future inclusion, in Statistics Canada's estimates of economic activity in the environmental and clean technology sector. The tables indicate which technologies and services were included in SEGS 2012 and SEGS 2015. They will be updated for future survey cycles as the scope of what is considered to be an environmental or clean technology good or service evolves.

Table 1 Environmental protection activities

**Table 1a
Protection of air and climate**

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Air, environment & remediation			
Emission control	Emission control	N	Y
	Clean coal processing technologies	N	Y
	Carbon capture technologies	N	Y
	Carbon storage technologies	N	Y
Monitoring and compliance	Leak detection technologies (ultrasonic detection and measurement, gas leak detection)	N	Y
	Environmental measurement apparatus	N	Y
Air pollution or flue gas or greenhouse gases management	Software	N	Y
	Platform or system	N	Y
	Sensors	N	Y
	Other	N	Y
Physical/chemical/biological treatment of air pollution or flue gas	Filters (membrane, baghouse, granular bed), cyclones	Y	Y
	Electrostatic precipitator	Y	Y
	Scrubbers (Venturi, spray tower, mechanical, plate tower, packed tower)	Y	Y
	Waste gas absorber, waste gas flare/incinerator	Y	Y
	Industrial catalytic converter	Y	Y
	Pollutant recovery condenser	Y	Y
	Adsorbers	Y	Y
Industrial air pollution or flue gas or greenhouse gas services	Emissions trading services	N	Y
	Generation of compliance units, surplus allowances, emissions performance credits, offset credits	N	Y
	Preparation of emissions reports and verification services	N	Y
	Allowance auctioning services, exchange platform provision services	N	Y
	Market monitoring services	N	Y
	Offset protocol development and validation services	N	Y
	Development of compliance systems, electronic emissions reporting system	N	Y

Table 1b
Wastewater treatment and municipal sewage treatment

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Water and wastewater			
Physical/chemical treatment of industrial wastewater	Tanks (including components) for dilution/equalization, neutralization, sedimentation, chemical precipitation	Y	Y
	Oil separator/skimmer	Y	Y
	Ion exchange bed	Y	Y
	Air stripping tank/column	Y	Y
	Liquid extraction column	Y	Y
	Micro-porous membrane adsorber	Y	Y
	Equipment for advanced chemical oxidation/UV radiation	Y	Y
	Pre-treatment filters	Y	Y
	Chemicals used in industrial wastewater treatment	Y	Y
Centralized physical/chemical and biological treatment of sewage	Intake screen	Y	Y
	Air sparging grit chamber	Y	Y
	Oil separator/skimmer	Y	Y
	Tanks (including components) for sedimentation, chemical precipitation/flocculation, aerobic biological treatment, aeration, clarification, disinfection	Y	Y
	Membrane bioreactor	Y	Y
	Trickling filter	Y	Y
	Chemicals used in municipal sewage treatment	Y	Y
Wastewater management system/ services	Software	N	N
	Platform or system	N	N
	Sensors	N	N
	Vehicles	N	N
	Other	N	N

Table 1c
Management of non-hazardous waste

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Waste and recycling			
Collection	Collection vehicles for non-hazardous waste, recycling and organics	Y	Y
	Containers for collection of recycled materials and household organics, backyard composters, yard waste	Y	Y
Separating and sorting	Air classifier, magnetic separator, eddy current separator	Y	Y
Compaction	Balers, densifiers, compactors, shredders, granulators	Y	Y
Centralized biological reprocessing	Centralized composters (turned-windrow, aerated static pile, mechanically agitated in-vessel)	Y	Y
Disposal	Equipment for landfill leachate collection and containment	Y	Y
	Equipment for landfill gas management	Y	Y
	Equipment for thermal treatment (rotary kiln incinerator, mass burning, starved air incinerator, fluidized bed)	Y	Y
Waste	Software	N	N
	Platform or system	N	N
	Sensors	N	N
	Other	N	N
Recycling	Recycling equipment and related services	N	N

Table 1d
Protection and remediation of soil, sediment, sludge, groundwater, surface water, and leachate

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Air, environment & remediation			
In situ physical/chemical treatment of soil, sediment, and sludge	Chemical oxidation, fracturing, soil flushing, soil vapour extraction, solidification/stabilization Include sales of chemicals for remediation of soil, sediment and sludge	Y	Y
Ex situ physical/chemical treatment of soil, sediment, and sludge	Chemical extraction, chemical reduction/oxidation, dehalogenation, separation, soil washing, solidification/stabilization Include sales of chemicals for remediation of soil, sediment and sludge	Y	Y
In situ biological treatment of soil, sediment, and sludge	Bioventing, enhanced bioremediation, phytoremediation	Y	Y
Ex situ biological treatment of soil, sediment, and sludge	Biopiles, composting, landfarming, slurry phase biological treatment	Y	Y
In situ thermal treatment of soil, sediment, and sludge	Hot air injection, electrical resistance	Y	Y
Ex situ thermal treatment of soil, sediment, and sludge	Incineration, pyrolysis, thermal desorption	Y	Y
Water and wastewater			
In situ biological treatment of groundwater, surface water, and leachate	Enhanced bioremediation, phytoremediation	Y	Y
Ex situ biological treatment of groundwater, surface water, and leachate	Bioreaction	Y	Y
In situ physical/chemical treatment of groundwater, surface water, and leachate	Air sparging, bioslurping, chemical oxidation, directional wells, dual phase extraction, thermal treatment, hydrofracturing enhancements, in-well air stripping, passive/reactive treatment walls Include sales of chemicals for remediation of ground water, surface water and leachate	Y	Y
Ex situ physical/chemical treatment of groundwater, surface water, and leachate	Adsorption/absorption, advanced oxidation, air stripping, ion exchange, precipitation/flocculation/coagulation, separation, sprinkler irrigation Include sales of chemicals for remediation of ground water, surface water and leachate	Y	Y
Control, containment, and monitoring services (air, water, soil)	Landfill cap, landfill cap enhancements/alternatives, physical barriers, deep well injection	Y	Y
Treatment of air emissions or off-gas	Oxidation, scrubbing, vapour phase	Y	Y
Other	Carbon adsorption	Y	Y
Treatment of drinking water / filtration systems	Microscreening	N	N
	Chemicals used in drinking water treatment	N	N
	Equipment for advanced chemical oxidation/UV radiation	N	Y
	Fluoridation	N	N
	Alkalinity adjustment for process control	N	N
	Corrosion control - pH adjustment	N	N
	Coagulant	N	N
	Flocculation	N	Y
	Tanks (including components) for dilution/equalization, neutralization, sedimentation, chemical precipitation	N	Y
	Membrane bioreactor	N	Y
	Air stripping tank/column	N	Y
	Ion exchange bed	N	Y
	Greensand filtration	N	N
Micro/ultrafiltration	N	N	
Electrodeionization	N	N	
Reverse osmosis or nano filtration	N	N	

Table 1e
Other environmental protection activities

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Air, environment & remediation			
Noise and vibration abatement	Goods and services for noise insulation in buildings	N	N
	Noise insulation works	N	N
Protection of environment	Site remediation services	Y	Y
	Environmental emergency response services	Y	Y
Protection against radiation	Radioactive waste management, decommissioning, and site remediation	N	N
Other EP	Research & development	N	N
	Training	N	N
	Consulting & administrative services	N	N

Table 2

Sustainable resource activities - energy

Table 2a
Alternative fuel production

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Biofuels and bioenergy			
Biofuel production	Grain ethanol	N	N
	Cellulosic ethanol	N	N
	Biodiesel	N	N
	Algae biodiesel	N	N
	Biobutanol	N	N
	Methanol and Dimethyl Ether	N	N
	Syngas biofuels	N	N
	Drop-in synthetic fuels	N	N
	Biofuel oil	N	N
	Biogas	N	N
	Renewable natural gas	N	N
	Hydrogen (produced from non-fossil sources)	N	N
	Renewable diesel	N	N
	Pyrolysis oil	N	N
Engineering services	N	N	
Bioenergy production	Chips, cubes, briquettes, pucks, and pellets from wood residues and grasses etc.	N	N
	Black pellets	N	N
	Other Biomass	N	N
	Biochar	N	N
	Fuel wood and other wood	N	N
	Engineering services	N	N

Table 2b
Renewable / non-emitting electricity and heat production

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Renewable / non-emitting energy supply			
Wind energy	Wind turbine equipment, including nacelles, blades, towers	Y	Y
	Wind turbines	Y	Y
	Switchgears, transformers	Y	Y
	Engineering, installation, maintenance, and architectural services	N	N
Bioenergy	Domestic woodstoves, wood pellets, including own use by households and industry	Y	Y
	Biomass-fired industrial boilers	Y	Y
	Anaerobic digesters	Y	Y
	Engineering, installation, maintenance, and architectural services	N	N
Geothermal energy	Heat pumps, heat exchangers, other equipment used in geothermal energy systems	Y	Y
	Hydrothermal equipment	N	N
	Hot dry rock (HDR) equipment	N	N
	Advanced drilling and exploration equipment	N	N
	Engineering, installation, maintenance, and architectural services	N	N
Hydro energy	Turbines and components for wave/tidal energy	Y	Y
	Turbines and components for run-of-river hydro	Y	Y
	Turbines (Francis, Kaplan, Pelton, propeller) and components for large hydro	Y	Y
	Generators (including components), valves, gates, transformers, switchgear	Y	Y
	Salinity gradient power equipment	N	N
	Engineering, installation, maintenance, and architectural services	N	N
Solar energy	Active (thermal) solar heating & cooling equipment (glazed flat plate collectors, glazed evacuated tubes/collectors, unglazed panels/collectors for heating pools, perforated cladding for solar air heating)	Y	Y
	Active (thermal) solar power generation equipment (concentrating mirrors, receivers)	Y	Y
	Solar photovoltaic energy equipment (photovoltaic cells, modules, panels/arrays, inverters for solar photovoltaic systems)	Y	Y
	Thin film solar PV (nanotechnology)	N	N
	Engineering, installation, maintenance, and architectural services	N	N
Waste to energy	Organic (liquid) waste to energy	N	N
	Organic (solid) waste to energy	N	N
	Landfill gas to energy	N	N
	Engineering, installation, maintenance, and architectural services	N	N
Nuclear energy	Nuclear reactors, or nuclear island components (primary circuit, steam generators, primary side auxiliaries, nuclear island electrical supply and instrumentation and controls)	N	N
	Nuclear fuel handling, processing, and fabrication equipment	N	N
	Balance of nuclear power plant, or conventional island components	N	N
	Engineering, installation, maintenance, licensing support, and architectural services	N	N
	Uranium processing, conversion, and nuclear fuel fabrication services	N	N

Table 2c
Smart grid & energy storage

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Smart grid			
Demand management	Inverters	N	Y
	Smart meters	N	Y
	Phasor measurement units / sensors	N	Y
	Management systems (communication solutions, monitoring and automation, software)	N	Y
	Engineering, installation, and maintenance services	N	N
Transmission and distribution	Transmission and distribution management	N	N
	Microgrids	N	N
	Local & district heating equipment and related services	N	N
	Other related ICT equipment	N	N
	Engineering, installation, and maintenance services	N	N
Energy storage			
Mechanical energy storage	Flywheels	N	Y
	Pumped hydro	N	Y
	Compressed air	N	Y
Electrochemical energy storage (advanced batteries)	Nickel Cadmium (NiCd)	N	Y
	Nickel Metal Hydride (NiMH)	N	Y
	Lead acid (LA)	N	Y
	Lithium-Ion (Li-ion)	N	Y
	Sodium Sulphur (NaS)	N	Y
	Sodium Nickel Chloride (NaNiCl)	N	Y
	Hybrid flow	N	Y
	Redox flow	N	Y
	Hydrogen storage	N	Y
	Fuel cells	N	Y
	Synthetic Natural Gas	N	N
Electrical storage	Double-layer and super/ultra Capacitors (DLC)	N	Y
	Superconducting Magnetic Energy Storage (SMES)	N	Y
Thermal storage	Thermal storage systems	N	Y
Hybrid storage	Hybrid storage systems	N	N
Energy storage services	Engineering, installation, and maintenance services	N	N

Table 2d
Substitutes for fossil fuels and fossil fuel-based materials (bioproducts)

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Biofuels and bioproducts			
Equipment for producing biofuels and bioproducts	Mixers/centrifuges	N	Y
	Filtration systems	N	Y
	Biofuel reactors (distillation towers, digesters)	N	Y
	Washers	N	Y
	Dryers	N	Y
	Heaters	N	Y
	Storage systems	N	Y
	Additives/catalysts (e.g., sodium hydroxide, potassium hydroxide)	N	Y
	Shredders, chippers	N	Y
	Dust collectors	N	N
	Conveyors	N	N
	Other conversion technologies/equipment	N	Y
	Biochemicals	Lubricants, waxes, and grease	N
Bio-oils & derivatives		N	N
Resins		N	N
Bioplastics and packaging		N	N
Acids		N	Y
Sugars (C5, C6), cellulose esters, polyols		N	N
Other building block chemicals		N	N
Paints, coatings, solvents, adhesives		N	N
Other bio-based specialty chemicals		N	N
Bio-pesticides and bio-stimulants		N	N
Bio-catalysts and bio-enzymes		N	N
Biofoam (insulation) and biorubber		N	Y
Lignin		N	N
Hemicellulose		N	N
Biomaterials	Biocomposites & Biofibres	N	Y
	Advanced materials (e.g., nanomaterials, nanocomposites, nanocrystalline cellulose, silk fibres)	N	N
	Cross laminated timber	N	N
	Wood composite	N	N
	Agri-based composite	N	N
	Textile	N	N
	Mats and specialty cellulose products	N	N
	Panels, cement, and other building products	N	N
	Automotive and transportation products	N	N
	Furniture and Consumer Goods	N	N
Other	Reclaimed rubber or other petro-based materials	N	N

Table 2e
Technologies to improve energy and resource efficiency / management

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Energy efficiency			
Energy & resource efficient modifications, improvements	In process (ancillary/own use) modifications	N	N
	Combined heat and power and cogeneration	N	N
	Enhanced solvent extraction for oil sands	N	N
	Fuel control systems	N	N
	Material/waste recovery and related services	N	N
	Energy recovery and related services	N	N
	Low-energy/passive buildings and related services	N	N
	Energetic refurbishment of existing buildings and related services	N	N
	Advanced thermostats	N	N
	Advanced insulation activities	N	N
	Collaborative consumption systems	N	N
	Additive manufacturing	N	N
	Measurement, controls and monitoring	Energy Audit for houses, buildings, industries and fleets	N
Energy efficiency certification (such as energy star for products, R-2000 for houses, BOMA Best for buildings, ISO 50001 for industry)		N	Y
Energy management system services		N	N
Energy monitoring services		N	N
Demand control services		N	N
Process integration services		N	N
Data analysis and modelling services		N	N
Automation and control technology		N	N
Uncertified green property investments		N	N
Green building certification	N	Y	
Industrial design and related services	Aerodynamic design	N	N
	Aerodynamic testing	N	N
	Modelling tools and services	N	N
	Energy efficiency consulting services	N	Y
	Design of emission control technologies	N	N

Table 3

Sustainable resource activities - water

Table 3a
Reduction of water use, losses

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Water and wastewater			
Water efficiency	Planning and design	N	N
	Efficiency consulting	N	N
	Laboratory	N	N
	Piloting, validation and verification	N	N
	Training and plant operation	N	N
	Equipment to reduce water consumption	N	N
	Processes for desalinated water	N	N
	Rainwater collection	N	N
	Pipe inspection	N	N

Table 3b
Water management

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Water and wastewater			
Measurement and control of water use	Software	N	N
	Platform or system	N	N
	Sensors	N	N
	Information and communication technologies	N	N

Table 3c
Water recycling

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Water and wastewater			
Recycling	Gray water reuse	N	N
	Water recycling technologies	N	N

Table 4
Sustainable resource activities - Agriculture, Forestry and Biodiversity

Table 4a
Agriculture

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Precision agriculture, forestry, biodiversity			
Precision inputs	Precision fertilizers and other inputs (e.g., smart seeds)	N	N
Machinery and equipment	Variable rate/precision (GPS enabled) seeders, fertilizer applicators, sprayers, etc.	N	N
	Sensors (crop canopy, yield etc.)	N	N
	PA decision support software packages for seeding, spraying, fertilizing, irrigating	N	N
	UAV drones with/for agricultural platforms	N	N
	Ionophores for livestock feed	N	N
	Livestock precision feeding technology (RFID sensors, automated feeders)	N	N
	Anaerobic digesters	N	N
	Other	N	N

Table 4b
Aquaculture

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Precision agriculture, forestry, biodiversity			
Aquaculture	Alternative feeds (plant, algal, yeast-based proteins to replace fish meal consumption)	N	N
	Fish waste reduction/recycling (solid and liquid waste collected/filtered)	N	N
	Conversion to land-based culture (e.g., Recirculating Aquaculture System (RAS))	N	N
	Energy efficient pumps, filters, processes	N	N
	Organic aquaculture products and supporting services	N	N

Table 4c
Wild flora and fauna

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Precision agriculture, forestry, biodiversity			
Wild flora and fauna management	Minimization of the intake of wild flora and fauna	N	N
	Restoration activities	N	N
	Measurement, control, and laboratories for wild flora and fauna management	N	N
	Training and administrative activities related to flora and fauna management	N	N

Table 4d
Forestry

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Precision agriculture, forestry, biodiversity			
Sustainable forestry	Management of forest areas (including restoration, replenishment, development of new forest areas, and prevention and control of fires)	N	N
	Minimization of the intake of forest resources	N	N
	Measurement, control, and laboratories for forest management	N	N
	Training and administrative activities related to forest management	N	N

Table 5 Sustainable resource activities - Minerals

**Table 5a
Minerals**

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Materials, manufacturing & industry			
Mineral use	In-process modifications to reduce consumption of mineral resources	N	N
	Production of substitutes for minerals-based materials	N	N
	Measurement/control related to the reduction of the use of minerals	N	N
	Recovery of mineral-based materials	N	N
	Machinery for metal recovery	N	N
Green mining	Enhanced solvent extraction	N	N
	Sustainable mineral processing	N	N

Table 6 Adapted goods

**Table 6a
Energy efficient equipment & appliances**

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Energy efficiency			
Efficient industrial equipment	High efficiency burners and boilers	N	N
	High efficiency pumps and motors	N	N
	High efficiency industrial HVAC	N	N
	High efficiency industrial lighting system	N	N
	Batteries for portable devices	N	N
Efficient commercial/residential equipment	High efficiency commercial/residential HVAC	N	N
	High efficiency electric appliances	N	N
	High efficiency lighting system	N	N

Table 6b
Sustainable mobility

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Transportation			
Fuel efficient automotive equipment	Fuel efficient engines and components (including electrification and hybrids)	N	N
	Electric vehicle battery	N	N
	Electric vehicle other components	N	N
	Fuel cell vehicle FC stack	N	N
	Fuel cell vehicle other components	N	N
	Automobile components using lightweight materials	N	N
	Electric vehicle infrastructure (charging stations)	N	N
	Alternative fuel (including hydrogen & natural gas) refueling infrastructure	N	N
	LNG/CNG engine	N	N
	LNG/CNG tank	N	N
	LNG/CNG control system	N	N
	Aerodynamic device	N	N
	Auxiliary power unit	N	N
	Engine control module	N	N
	Low rolling resistance tire	N	N
	Vehicle emission monitoring	N	N
	Alternative fuel retrofits	N	N
	Technical inspection services related to air emissions	N	N
Fuel efficient aerospace equipment	Efficient turbine	N	N
	Fuel efficient engines (including electrification and other alternative fuels)	N	N
	Additive composite	N	N
	Aircraft components using lightweight materials	N	N
	Powder metallurgy, coatings, polishing, anodizing for fuel efficiency	N	N
Infrastructure and traffic control	Intelligent traffic control	N	N
	Integrated traffic infrastructure	N	N
	Traffic management	N	N
Other	Car sharing	N	N
	Electric and more resource efficient transport equipment	N	N
	Vehicle fleet management & logistics	N	N

Table 6c
Advanced materials

Industry and sub-industry	Technology area / type of service	SEGS 2012	SEGS 2015
Materials, manufacturing & industry			
Advanced/lightweight materials	Products developed using additive manufacturing or low-impact processes	N	N
	Nanotechnology	N	N
	Compound materials	N	N
	Advanced packaging	N	N
	Other lightweight materials	N	N