



# ICTs and environmental sustainability:

# Mapping national policy contexts – Mexico baseline study

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# 1. Introduction

Information and communications technologies (ICTs) have transformed the way of managing information on climate change, previously the reserve of the academic or political sectors. ICTs have generated "new tools for managing, monitoring, planning and learning, as well as opportunities for dialogue and participation through the dissemination of experiences and the establishment of forums." (Bermeo, u.d.).

Are these technologies actually being used in Mexico for actions in response to climate change? This study is focused on identifying the uses of ICTs proposed in public policies for monitoring, strategy, adaptation and mitigation actions related to climate change in Mexico. Through this process, the intention is to identify the attention these technologies have received in policies linked to an environmental issue that has become a threat to the planet.

This study also attempts to review the current state of the digital and environmental agendas (particularly the climate change agenda) and identify points in common and points related to ICTs. The aim is to emphasise the need for analysis of the positive and negative effects of ICTs in the national context.

Certain aspects regarding e-waste are also touched on. Mexico has made some progress in the management of e-waste, but also faces numerous challenges. One of the most important is the lack of information about the dangers of e-waste, while there remains a lack of formal infrastructure for handling discarded technology.

The intention of this report is to approach the question of ICTs and environmental sustainability from the perspective of the population's well-being and environmental sustainability. It does not represent the perspective of interests that are oriented towards taking advantage of an environmental crisis to expand the technology market, or participating in "financial opportunities" that are becoming popular among many governments through Clean Development Mechanisms proposed in international negotiations.

## 2. Overview of key findings

There is very little recognition of the potential impact of ICTs in Mexico when it comes to environmental sustainability: both in terms of their negative effects on the environment, and in the positive sense that they can be harnessed as tools for mitigating and dealing with the effects of the climate change.

Actions in response to climate change are gaining strength in Mexico. In addition to the public policies at federal level, a number of states are also developing state-level laws. The use of ICTs is implied in these documents.

Various attempts have been made in Mexico to formulate digital agendas and public policies on ICTs. However, the proposals for a digital agenda do not consider the issue of climate change or the need for initiatives to deal with it.

There is a very weak link between the country's digital strategies and environmental strategies involving climate change or e-waste. Public policies in the two fields do not overlap. The gap in public policies regarding pushing ICTs towards the "clean" or "intelligent" categories risks placing Mexico in the least favorable end of the "mitigation divide" (Ospina et al., 2010) – and this with the threat of broadening the digital divide. A key gap involves the proposal of measures to use technologies in an environmentally sustainable way in terms of reducing the country's carbon footprint.

ICTs have an obvious role to play in building networks, and civil society has been active in its campaigns in response to unfair socio-economic conditions, exacerbated by environmental factors such as floods, droughts and soil degradation. Part of the root causes of numerous current social and economic problems, including migration, unemployment, and insecurity, may be found in the environmental deterioration and degradation of the country's ecosystems. Already existing poverty conditions are aggravated by the effects of climate change.

There is no record in official documents such as policy documents, plans and programmes of criticism of the predominant models of ICT consumption in contemporary society. This means that there are no initiatives encouraging society to reduce high, irrational and unfair consumption of technological products and services by part of the population.

Unequal access to ICTs is a result of economic and social inequality in Mexico. The demand for universal access and connectivity becomes an essential condition for the necessary monitoring, adaptation, and mitigation strategies in the country.

Many toxics have been eliminated of the Mexican ICT industry thanks to the adoption of environmental protection measures such as the Restriction of Hazardous Substances Directive (RoHS). However, this has not impeded the continued use of other substances such as flux, tin, acetones, some acids and epoxy composites. As a result, close to 4,000 workers in the ICT industry as a whole are still exposed to toxic substances.

Mexico has achieved some advances in the management of e-waste, but many challenges remain. These include information on e-waste, awareness raising, a clear understanding of the final destination of discarded technology, and formal systems to manage e-waste. Recycling is not a common practice in the country yet.

## 3. Objectives of study

The following were the key objectives to this study:

- Identify the uses of ICTs that have been proposed in public policies for monitoring, strategic, adaptation and mitigation actions in response to climate change in Mexico.
- Identify the points shared by digital and climate change policies in Mexico.
- Emphasize the needs for analysis and action in relation to the production, consumption, use and disposal of ICTs from a perspective of social and environmental justice.
- Offer information for reflection and analysis, to be considered by communities and governments in the creation of strategies, monitoring, mitigation and adaptation to climate change using ICTs.

The report is part of the newly-created programme by the Association for Progressive Communications (APC) in the field of ICTs and environmental sustainability. It accompanies an inventory of sustainable tools and practices, and policy research into ICTs and environmental sustainability in four other countries: India, Bangladesh, Egypt, and Costa Rica. The survey, inventory and research have been made possible through funding from the International Development Research Centre (IDRC). This research and other activities in the APC programme area can be accessed on the organisation's website: www.apc.org

## 4. Methodology

This work is based on the need to link ICTs with sustainable development and the environment. In this report, ICTs and environmental sustainability is a broad and inclusive definition. It involves the environmentally sound and sustainable management of ICTs, including their production, use, re-use and disposal. Importantly, it also involves using ICTs to mitigate, and adapt to climate change. Finally, ICTs can be used more generally in support of environmental causes, or as tools to assist in protecting and preserving the environment. The particular focus of this analysis, is on the efforts at actions in response to climate change, and on public policies and initiatives carried out in Mexico in relation to this phenomenon. While e-waste is referred to, it is within the context of the over-riding environmental concern currently being the national and global response to climate change.

To do this we considered the overview model on ICTs, climate change and development proposed by Ospina and Heeks (2010), and we borrowed some aspects of its four major components (described here) to integrate them into an analysis of Mexico's reality, in relation to its public policies on the use of ICTs to confront climate change:

- **Action strategy.** Considered here are decision-making processes, policy networks, awareness and capacity building, and technology transfer.
- **Monitoring.** Includes data capture, data processing and data presentation and dissemination —all critical to supporting decision-making processes.
- **Mitigation.** In which the three components associated with ICTs can be observed. The direct impacts associated with the production of these technologies, their operation, their disposal, and the energy they require. The indirect impacts linked to ICT applications such as transportation systems and intelligent buildings. In addition, the rebound effect, which considers effects on human behavior, such as consumption models that can be positive or negative.
- **Adaptation.** Understood as the capacity to adjust to systems, which becomes evident when responses are given or actions are taken. Ospina et al., (2010) points out that the potential of ICTs in processes of adaptation to climate change can be associated with the following key livelihood assets: water, habitat, health, livelihoods and finance, and socio-political processes.

Part of this research has also involved reviewing official documents produced by the Mexican government on the topic of climate change, as well as articles and news on the same phenomenon. A similar review was done regarding public policies on ICTs. Meetings with individuals in the government were sought – however it was difficult to obtain interviews with them. Nevertheless, there was success in securing interviews with scientists and members of civil society organisations that work in the areas of environmental justice, climate change and social use of ICTs.

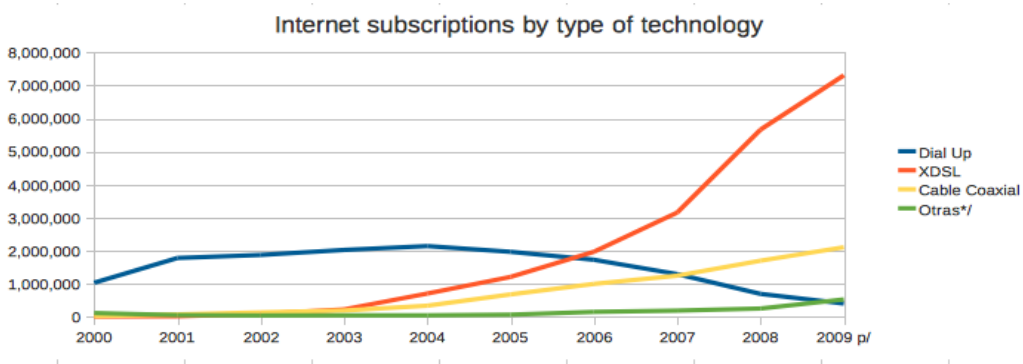
## 5. Key data for analysis

The quantitative data presented below reflect the country's status regarding the use of ICTs in Mexico and some aspects related to education, markets, industry and environment.

1. Mexico has the second largest number of different ecosystems worldwide and the fourth greatest variety of species. (CICC, 2009)
2. It is among the most vulnerable countries in the world when it comes to climate change. A total of 68.2% of its population is highly exposed to the risk of direct adverse impacts from climate change, as is 15% of its national territory. Climate change can be said to place 71% of the country's GDP at risk. (Greenpeace, 2010)
3. It is estimated that close to 36-million residents of coastal municipalities are likely to suffer the consequences of tropical cyclones, if emissions of $CO_2$ are globally exceeded by more than 450 ppm. One in three Mexicans lives in areas subject to flooding. (Anzaldo, 2008 by Graizbord, 2010)
4. Emissions in carbon dioxide equivalents ($CO_2$ eq) for Mexico were 709,005 Gg in 2006. (CICC, 2009)
5. Of the green-house gass emissions registered in Mexico in 2006: the energy category accounted for 60.7% of emissions with 430,097 Gg, followed by waste with 14.1% (99,627.5 Gg), land use, change of land use and forestry with 9.9% (70,202.8 Gg), industrial processes with 9% (63,526 Gg) and agriculture with 6.4% (45,552.1 Gg) (CICC, 2009).
6. Mexico's expenditure on Research and Development (R&D) as a percentage of GDP is less than 0.5%, compared with an average of over 2% in the Organization for Economic Cooperation and Development (OECD). (OECD, 2010)
7. Mexico has a population of 112,322,757 inhabitants – 27,206,174 of whom were internet users in 2009[1] according to INEGI (INEGI, 2010), and 34,871,724 according to COFETEL (2010). That same year, records show that the country had 5,119,437 households with internet and 83,578 million internet telephony users[2] (INEGI, 2010).

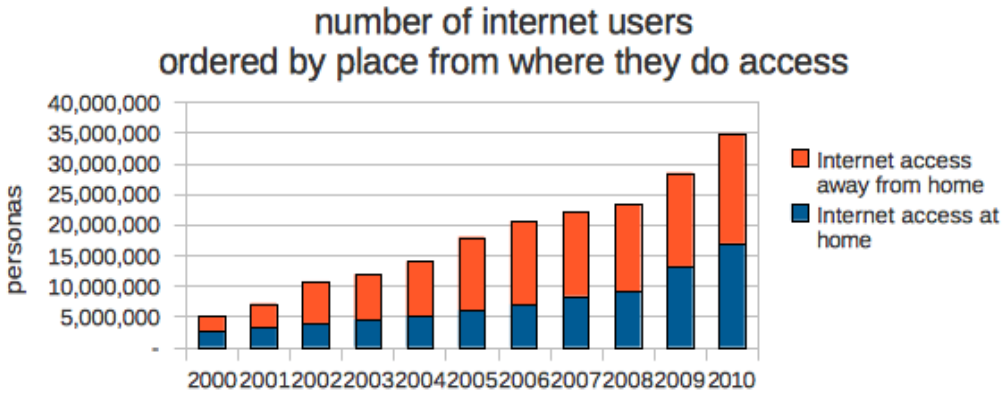
[1] Refers to the population aged six or over that has used the Internet anywhere over the past twelve months, through any device.

[2] Subscribers to a public mobile telephony service using cellular telephone, which enables them to gain access to the general switched telephone network. This includes analogous and digital systems. It includes subscribers to post-payment and pre-payment systems.



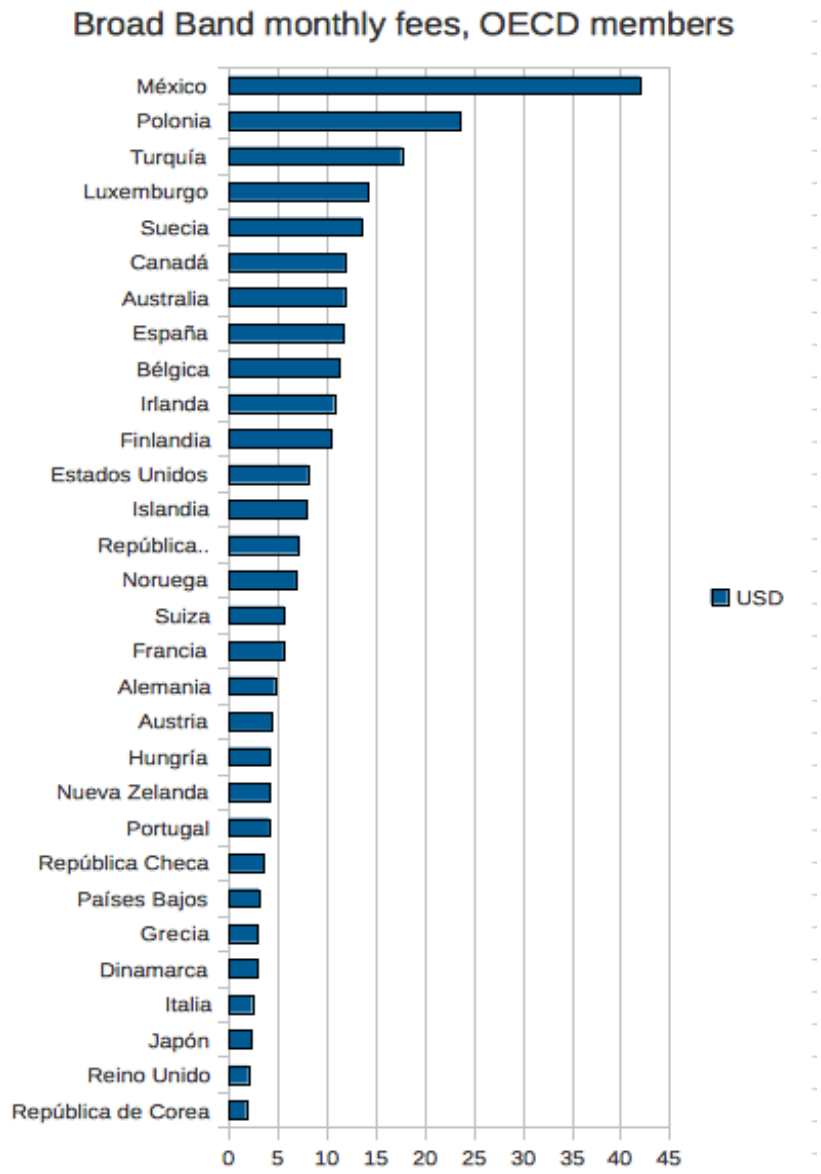

*Source: COFETEL. Internet subscriptions by type of technology. August 2010, Web.*

8. Only 30 out of 110 million Mexicans currently have access to the internet, according to the Asociación Mexicana de Internet (AMIPCI). (SDPNoticias.com, 2010)
9. Mexico has the second lowest broadband density of all the countries in the OECD, which states that the country's download speed continues to be slow as a result of insufficient investment in infrastructure. (OECD, 2010)




*Source: INEGI. Estadísticas sobre Disponibilidad y Uso de Tecnología de Información y Comunicaciones en los Hogares, 2009. Instituto Nacional de Estadística y Geografía. Mexico.*

10. Some of Mexico's broadband services are among the most expensive in the OECD, with lower speeds than those available in other countries. The prices paid by Mexican subscribers are much higher than those of other countries in this group. (OECD, 2010).




*Source: OECD.*

11. According to the The International Telecommunication Union (ITU) cellphone rates fell dramatically between 2008 and 2009 – a 52% reduction. (ITU, 2010). However the OECD states that Mexico continues to be one of the countries in this organization with the most backward telecommunications infrastructure and the highest prices for telephone services (OECD, 2010).

12. Only two operators control nearly 90% of the cellular telephone market. Telcel has 75% of subscribers, while Telefónica Movistar has 15% of the subscribers to this service in Mexico. (El Economista, 2010)
13. Telmex registered 15,622,000 landlines billed for September 2010 (CNN expansion. (Ugarte, 2010) The Secretariat of Communications and Transport has registered a total of 19,754,358 fixed telephony numbers (SCT, 2010).
14. Mexico registered 3.25 on the ICT Development Index (IDI) in 2010, ranking 77th out of a list of 159 countries. (ITU, 2010) The country's ranking in The Global Information Technology Report 2009-2010 undertaken by the World Economic Forum has dropped. It fell from 67th position last year to 78th out of a total of 133 countries. (Sepúlveda, 2010).
15. Approximately 300,000 tons of e-waste is produced in Mexico annually, which is increasing at the rate of 6% a year (Méndez, 2011).
16. Over the past two years, the average salary of a worker in the electronic industry fell from 100 to 90 pesos (from USD8.3 to USD7.5). The percentage of workers with temporary contracts rose from 40% in 2007 to 60% by late 2009, while 90% of the workers in this sector belong to trade unions which they know very little about. (CEREAL, 2009)

## 6. Key stakeholders and initiatives

As in other countries, the ICT sector in Mexico has myriad stakeholders, including government, business, and academic institutions and civil society organisations. However, only a small number of them participate in the ICT4D sector, and even fewer are involved in initiatives dealing with ICTs and climate change. In this section, however, we make note of the main entities or collectives that have been involved in developing proposals for public policies related to ICTs or proposals for the social use of these technologies, which are sometimes linked to the environment.

Specifically in the area of climate change, we also find actors in government, business, academic and civic society sectors. Although it is difficult to develop a list that includes all of these actors, we will present some of them that are particularly outstanding for their participation in and development of proposals dealing with the mitigation and monitoring of, and adaptation to climate change. In the case of e-waste we list some actors active in the attempt to understand and to improve e-waste management in Mexico.

**Government**

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| **SCT, Secretaría de Comunicaciones y Transportes (Ministry of Communications and Transportation).**<br><br>**Unidad de la Coordinación para el Desarrollo de la Sociedad de la Información y el Conocimiento (CSIC) (Coordination Unit for the Development of the Information and Knowledge Society)** | Responsible for proposing and guiding policies for the development, implementation and coordination of the National e-Mexico System. |
| **Comisión Intersecretarial de Cambio Climático (CICC) (Inter-sector Commission on Climate Change)** | Coordinates the actions of Federal Public Administration entities related to national policies on GHG emissions, adaptation and climate action strategies and programmes. Representatives from seven government ministries participate. |
| **Consejo Consultivo de Cambio Climático (CCCC) (Advisory Council on Climate Change)** | Monitors the CICC's compliance with its functions. Evaluates its performance and makes recommendations. |
| **Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) (Ministry of the Environment and Natural Resources)** | One of the responsibilities of this ministry is to guide national policies on climate change and e waste, between other environmental topics. |

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| **Instituto Nacional de Ecología (INE) (National Institute of Ecology)** | Its mission includes conducting investigations on climate change in Mexico related to both mitigating and adapting to climate change. The Dirección General de Investigación sobre la Contaminación Urbana y Regional (General Direction of Research on Urban and Regional Contamination) works in the diagnosis on the generation of electronic residues. |
| **Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO) (National Commission for the Knowledge and Use of Biodiversity)** | This is an inter-sector commission whose mission is to promote, coordinate, support and carry out activities directed toward knowledge of biological diversity, its conservation and its sustainable use. |
| **Secretaría de Medio Ambiente (SMA) (Ministry of the Environment), Mexico City.** | Has a Department for the Climate Change Programme and Clean Development Mechanisms Projects. |
| **Instituto de Ciencia y Tecnología del Distrito Federal (Mexico City Institute of Science and Technology).** | Supports research projects. Its programmess include work on a sustainable city, connectivity and technology; and education in science and technology. |
| **House of Representatives** | Digital Access Commission<br><br>Science and Technology Commission<br><br>Commission on Climate Change<br><br>Communication Commission<br><br>Commission on the Environment and Natural Resources |
| **Senate** | Special Commission on Climate Change<br><br>Science and Technology Commission<br><br>Communications and Transportation Commission<br><br>Commission on the Environment, Natural Resources and Fisheries<br><br>Civil Protection Commission |

**Industrial Chambers**

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| **Asociación Mexicana de la Industria de Tecnología de Información (AMITI) (Mexican Association of the Information Technology Industry)** | Seeks to position information technologies as a clear contributor to competitiveness in Mexico. |
| **Cámara Nacional de la Industria Electrónica, de Telecomunicaciones y Tecnologías de la Información (CANIETI) (National Chamber of the Electronics, Telecommunications and Information Technologies Industry)** | Promotes the development of the sector in a global setting to achieve its competitive development. |
| **Asociación Mexicana de Internet (AMIPCI) (Mexican Internet Association)** | Seeks to strengthen the internet economy. |

**Research**

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| **Centro de Ciencias de la Atmósfera (Center of Atmospheric Sciences).** | Is part of the Universidad Nacional Autónoma de México (National Autonomous University of Mexico). Has a research group on climate change and solar radiation. |
| **Centro Mario Molina de Estudios Estratégicos de Energía y Medio Ambiente (CMM) (Mario Molina Center for Strategic Studies on Energy and the Environment).** | Supports practical solutions to key problems related to energy and the environment. |
| **Centro Interdisciplinario de investigaciones y Estudios sobre Medio Ambiente y Desarrollo (CIIEMAD) (Interdisciplinary Center for Research and Studies on the Environment and Development).** | Academic unit at the National Polytechnical Institute. Conducts research on climate change. |
| **Programa de Investigación de Cambio Climático (Research Program on Climate Change).** | Develops the research agenda on climate change. |
| **Universidad Autónoma de San Luis Potosí (UASLP** | Researchers of the Environmental Toxicology Department in the School of Medicine have studied the health risks from the ingestion of foods contaminated with PBDEs (flame retardants). |

**Civil society organizations**

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| **Greenpeace México** | Greenpeace Mexico promotes the general Guide to Greener Electronics, which ranks the 18 top manufacturers of personal computers, mobile phones, TVs and games consoles according to their policies on toxic chemicals, recycling and climate change. |
| **Centro Mexicano de Derecho Ambiental (CEMDA) (Mexican Center on Environmental Law)** | Has an air and energy programme. |
| **Asamblea de afectados ambientales (Assembly of Persons Affected by the Environment)** | Network of affected organisations that seek to end social and environmental destruction, and to fight peacefully for the reconstruction of environmental conditions that will permit dignified, sustainable living. |
| **Marea Creciente (Rising Tide - Mexico)** | A network of organisations and activists taking action against the causes of anthropogenic climate change and in favor of climate justice. |
| **Otros mundos – Chiapas (Other Worlds – Chiapas)** | An interdisciplinary collective that seeks alternatives to social, economic, political and environmental crisis. It has a Climate Justice, Forests and Biodiversity Programme. |
| **OXFAM** | It is participating actively in the annual climate change summits (COPs). |
| **Proyecto Ecovía** | A non-profit recycling programme run solely by volunteers. Ecovía receives recyclable materials. Has participated in campaigns for recycling e-waste in Guadalajara, Jalisco. |
| **Red Mexicana de Manejo Ambiental de Residuos, REMEXMAR (Mexican Network for Environmental Waste Management.** | Remexmar organises public conferences and stages mass collections of used electronics products. |

**E-waste management companies**

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| **Recicla Electrónicos México (REMSA)** | Mexican electronics recycler specialised in the environmentally safe and socially responsible dismantling of e-waste. |
| **Mundo Rojo Traiding Industry** | Founded in the city of San Luis Potosi. Mundo Rojo offers collection and recycling services. |
| **Grupo Ecológico MAC** | A recycler based in Jalisco and Queretaro. |
| **EnviroTech** | A company based in Nuevo León. Offers services in the management, recovery and disposal of e-waste. |
| **Ecorecikla** | Mexican company located in Chihuahua in northern Mexico. Ecorecikla supports the Federal Government, State, municipalities, educational institutions, banks, private companies, and retail stores, amongst others, in the management of e-waste. |
| **Belmont Trading Company** | Belmont Trading Company located in the city of Guadalajara, Jalisco. It provides refurbishing for local and international markets. |
| **In Cycle Electronics México S. A.** | Offers various e-waste recycling services. |

**Digital Initiatives**

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| **Centro Virtual de Cambio Climático de la Ciudad de México (Virtual Center on Climate Change in Mexico City)** | Participates in the development of strategies, policies and measures for adaptation, the reduction of vulnerability, and mitigation of climate change. Monitors research and information on policy implementation. |
| **Website: El Cambio Climático en México. Información por Estado y Sector (Climate Change in Mexico: Information by State and by Sector)** | Represents an effort by INE/SEMARNAT and the Centre for Atmospheric Sciences. Included are data on climate threats, vulnerability, and climate risk projections. Also mentioned are some actions for adaptation to climate change for different sectors. |
| **Sistema Nacional de Información Ambiental y de Recursos Naturales y Sistema Nacional de Indicadores Ambientales Iniciativa de SEMARNAT (National System of Environment and Natural Resources Information, and National System of Environmental Indicators, a SEMARNAT Initiative).** | A reservoir of information, with periodic reports. |
| **Unidad de Informática para las Ciencias Atmosféricas y Ambientales (Information Unit for Atmospheric and Environmental Sciences)** | An initiative of the Centre for Atmospheric Sciences. |
| **Plataforma en Línea sobre Viviendas Sustentables (On-line Platform on Sustainable Housing) (Portal de viviendas, Housing port)** | Technical information on measures for saving energy and water, and disposing of waste. |
| **Calculadoras de huella de carbono (Carbon footprint calculators).** | There are various calculators, such as those used by Pemex and World Wildlife Fund (WWF)-Mexico. |

# 7. Policy and legislative analysis

## Background to policy context

The history of the use of ICTs in Mexico dates to the inauguration in 1958 of the Electronic Calculation Centre in the Sciences Department of the Universidad Nacional Autónoma de México (UNAM). An IBM 650 computer was unveiled that same year in the Centre's installations. This machine was primarily used for conducting calculations in basic applied scientific research projects and technological development. The national mood of the era meant avid interest to support research and to open up invention towards cutting-edge technologies.

However, for more than fifty years, that impulse in favour of a national project of scientific and technological development has come up against national and state policies that prioritize importation and consumption of technological products and tools over the nation's own research and development. This fact is confirmed by attempts in the House of Representatives to negotiate in favour of increased public expenditure for scientific and technological development and innovation. According to Grupo Vincula, formed by 11 academic and private sector bodies and state and federal entities,[3] the investment foreseen by the federal government for the current (2011) fiscal year is 47.781 billion pesos (just under USD4-billion) in the areas of science, technology and innovation. This represents real growth of barely 3.4% over the previous year. Grupo Vincula calls this amount insufficient, pointing out that "if this minimal growth rate is maintained, the investment proposed in the Law on Science and Technology (Ley de Ciencia y Tecnología), which calls for the equivalent of 1% of Gross Domestic Product (GDP) dedicated to these areas, will not be achieved until the year 2050" (De la Peña, 2010).

Another indication of this grave situation being suffered by the scientific community due to insufficient budgetary resources is offered by Jorge Flores Valdés, General Coordinator of the Consultative Council on Sciences of the Presidency of the Republic (www.ccc.gob.mx), who referred to the budget in the matter approved by Congress as "mediocre" and not very progressive. In response to the decision to grant the National Council on Science and Technology (Consejo Nacional de Ciencia y Tecnología – CONACYT) – the primary national entity for coordination of research projects – only 17.590 billion

[3]Some that may be noted include: the Mexican Academies of Sciences, Engineering, and Medicine, the Consultative Council of Sciences of the Presidency of the Republic, and the business representatives of the Business-owner Confederations of the Mexican Republic (*Confederaciones Patronal de la República Mexicana* –COPARMEX), the Industrial Chamber (CONCAMIN), the National Chamber of the Transformation Industry (CANACINTRA), the Mexican Association of Economic Development Ministers (*Asociación Mexicana de Secretarios de Desarrollo Económico*), and the National Network of State Councils and Bodies on Science and Technology (*Red Nacional de Consejos y Organismos Estatales de Ciencia y Tecnología*).

pesos (USD1.465- million) for 2011, he suggested that political leaders lacked the conviction to improve the situation regarding research and development. (Informador.com.mx, 2010).

For these reasons, part of the challenge related to ICT use in Mexico, and specifically regarding technologies dedicated to addressing the specific needs of mitigation, adaptation and monitoring of climate change, is that they are primarily technologies imported from various other countries to Mexico. We refer in particular to technologies employed in the fight against infectious diseases, flood prevention, and weather surveillance. In particular these include mobile telecommunications and internet in the development of information dissemination and consultation systems, the capture of aerial and satellite images and their interpretation, the creation of atmospheric models, the use of sensors to improve energy use efficiency, and water purification and its efficient use in agricultural irrigation systems, amongst others.[4] The fact that scientific and technological development is seriously limited by budgetary restrictions,[5] and the little private investment that exists in these areas, means that the only option is to import technologies. Moreover, this importation until now has been driven by market logistics, mostly through intermediary companies, making it more expensive and more difficult to take advantage of technologies already available in other countries.

One of the large wholesale importers and distributors of technology in Mexico is Ingram Micro (with representation centres in Tijuana, Hermosillo, Monterrey, León, Querétaro, Guadalajara, Mexico City, Puebla and Merida). This company reports that Mexico has provided its highest rates of return on investments in the years 2006, 2007, 2009 and 2010 (Ingram Micro, 2010).

While there appears to be competition within the wholesale IT distribution market in Mexico, we lack sufficient information to rule out the possibility that this competition may only be on the surface, given the possibility that companies of the same origin may present themselves under different names.[6]

An important element of the IT market in Mexico is that, in addition to the distribution chain, there is a growing industry of large manufacturing companies that conduct part of their manufacturing processes in Mexico, primarily in the Central and Northern regions of the country. Conditions fostered by the North American Free Trade Agreement and the corresponding agreement with Japan have led

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[4] For more information see: http://niccd.wordpress.com/author/angelicaospina/

[5] Mexico has a deficit of meteorological experts specialized in the climate change phenomenon –with only 15 in Mexico— and does not offer any university program to form new ones, according to Adrián Vázquez, general coordinator of the National Meteorological Service (See: El Economista. 3 December 2010. http://www.google.com/url?q=http%3A%2F%2Feleconomista.com.mx%2Fsociedad%2F2010%2F12%2F03%2Fmexico-sin-especialistas-cambio-climatico)

[6] In addition to Ingram Micro, we may mention other large importers and distributors distributed throughout Mexico: Intcomex-Centel , CVA, CT International, PC Hardware, Bell Micro Mexico, Sumitel, Exel, Compugolfo, Sistemas Aplicados, Computol, DC Mayorista, Team, Compucity-Odistore, Maycom, Calcom, Hergo Computers, Apolo-Tec, Compusoluciones, Azerty, Tech Data, MicroStar, Pacific.com.mx, Paguito.com, Texa and Symmex (as reported by the magazine: Boletín de la Computación. See: http://www.boletindelacomputacion.com.mx/encuestas/topmayoristas2010/).

Mexico to manufacture and assemble devices and components for many of the world's electronics giants.[7]

The globalisation of production processes that has resulted in Mexico's participation in the manufacture of these products, and its so-called "host industry" model, have not changed the terms of the country's commercial exchange with the rest of the world. However, processes may eventually be generated that modify the Mexican conditions of technological dependency if linkages are expanded with the academic activity of technological research and development centres within universities located in the proximity of the industrial parks in which the electronics industry operates. This situation could also change if a national project were constructed to encourage the industry to draw onits potential and think about developed the technical expertise of engineers and researchers.[8]

The Mexican ICT industry is characterized by low value-added, instability and volatility (CANIETI, 2004b). According to the Third Report issued by the Centre of Labour Reflection and Action (Centro de Reflexión y Acción Laboral -CEREAL) on labour conditions in Mexico's electronics industry, the global economic crisis led the industry to fire a total of 6,000 workers between 2008 and the third trimester of 2009. However, unlike other economic sectors, the situation changed for the industry after October 2009 as companies began to announce the arrival of new investments, the opening of new projects, and the hiring of workers. The result of this turnaround was that the jobs lost had been recovered by the end of that year, and positive growth was registered in employment, with at least 6,000 more job openings than before the crisis.(CEREAL, 2009. p. 6.)

In reference to worker's exposure to hazardous substances, the report notes that many toxics have been eliminated thanks to the adoption of environmental protection measures such as the Restriction of Hazardous Substances Directive (RoHS; put in place in 2006 by and for the European Union, barring entry into the community market of equipment with concentrations above defined limits for substances such as lead, mercury, cadmium, hexavalent chrome, polybrominated biphenyls, and polybrominated diphenyl ethers). However, this has not impeded the continued use of other substances such as flux, tin, acetones, some acids, and epoxy composites. As a result, based on interviews, CEREAL estimates that close to 4,000 workers are still exposed to toxic substances, and warns that the industry has refused to divulge information on this topic (CEREAL, 2009. p. 9).

[7] We refer primarily to: General Electric, IBM, HP, Flextronics, LG, Siemens, Motorola Ericsson, Seros, Ratheon, Sanyo and Philips, and to a lesser degree also to: Matsushita, Altec, Xerox, Canon, Sony, Samsung, Panasonic, Alcatel-Indetel and Toshiba (See: Instrumentación del Programa de Competitividad de la Industria Electrónica. Cámara Nacional de la Industria Electrónica de Telecomunicaciones e Informática, 2004. Volume I. p. 41 http://www.canieti.org/assets/files/434/Estudio_Electronica_Final_Vol_I.pdf).

[8] This could be the direction adopted by the Integrally-Planned Electronic Parks (Parques de la Electrónica Integralmente Planeados –PEIP), according to the proposal included in the Instrument for the Competitivity of the Electronics Industry of the National Chamber of the Electronic Telecommunications and Information Industry (Cámara Nacional de la Industria Electrónica de Telecomunicaciones e Informática-CANIETI) and that contemplates the participation of CONACyT – the federal government entity responsible for supporting and promoting science through the intervention of grant recipients in PEIP installations. However, it is important to recall that, as we have seen, the budget assigned to CONACyT falls far short of national needs (CANIETI, 2004a p. 41).

Conflict between workers and companies is also evident, attributable to the lack of respect for freedom of association, the use of temporary hiring contracts with the purpose to ignore accumulated labour histories and not generate greater rights, and the use of employment agencies to relegate labour relations to third parties through outsourcing schemes (CEREAL, 2009. p9).

This is in spite of the fact that the industry has social responsibility standards established in its Electronics Industry Code of Conduct (EICC). This Code stipulates that the companies that subscribe to the EICC must offer high standards of ethical conduct, and just, dignified and respectful treatment of workers (Paterson, 2010). These contradictions at the core of the ICT industry in Mexico have resulted in the formation of the National Coalition of Electronics Industry Workers (Coalición Nacional de Trabajadores de la Industria Electrónica). This Coalition has demonstrated publicly, with members preferring to use masks in light of fears of reprisals, to demand recognition of the labour rights for subcontracted workers (Covarrubias, 26 July 2009) –also demanding the distribution of shares of company profits, as mandated by law (Estrada, 2 July 2009).

Part of the root causes of numerous current social and economic problems, including migration, unemployment, and insecurity, may be found in the environmental deterioration and degradation of the country's ecosystems. Already existing poverty conditions are aggravated by the effects of climate change. While it is true that environmental problems affect the entire Mexican population, the most disadvantaged sectors are clearly those most affected, due to their economic vulnerability, lack of access to timely information, and scarce participation in public policy definition. Such is the case currently faced in the state of Veracruz, located in one of the country's regions most vulnerable to changes in temperature and rainfall patterns, and where a 5% increase is forecast in mortality rates due to acute diarrhoeal infections among children under five years of age by the year 2030, if adequate adaptation measures are not adopted. (La Jornada, 12 December 2010)

In the terrain of public policies oriented to mitigation of the causes of climate change, and the sphere of Integral Solid Waste Management, positive steps may be found in the creation of new business and profit generating opportunities for the (large) companies, both in global carbon shares market, and in the generation of markets of sub-products derived from recycling. This contrasts with the proposals posed by a broad sector of environmental organisations (according to personal interviews gathered during COP16) and a growing number of governments that cite the necessity to reduce the factors that contribute to the generation of green house gases throughout the planet – primarily in the countries identified as the highest producers -- or that promote the reduction of over-consumption and of production of goods with built-in obsolescence, while also offering a critique of the current global development model.

Another important factor to consider in the analysis is the high concentration of internet connection services in the hands of a select few companies. One of them, Telmex, which controls most of the landline telephone network and ADSL connectivity, maintains market control through a political and legal court strategy that has allowed it to keep its competitors in persistent disadvantage. This was done first by denying interconnectivity, and later, in response to social pressure, by offering them very

elevated connection costs, thereby preserving its predominance in the national market. The result is a broadband connection service that, according to data reported by the OECD, is five times more expensive than in the United States (OECD, p. 31). That same company, in the voice of its primary shareholder, Carlos Slim, promotes the use of technology in different spheres of development and has made public proposals on issues ranging from measures against climate change to policies to combat organized crime (Rodríguez, 21 November 2010). The security-related proposals coincide with the orientation given by the government to its National Strategy to Prevent Crime and Combat Delinquency, through the development of encrypted data networks, unified databases on organised crime, and the outfitting of military and policy stations organised in the so-called Mexico Platform, to which the government designated 2.561 billion pesos in 2009 alone, equivalent to USD215 million (Presidencia,gob.mx, 2009, CIAPEM, 2010).

It is very important to consider that the approach to fighting crime has been fundamentally repressive, framed in the logic of the internal war announced against drug trafficking, but which in reality also affects broad social groups. Such is the case for environmental organisations, now obligated to work and act in a context of threats and the imprisonment and assassination of their activists, at times with the complicity of the authorities. Some examples of the above are:

- The imprisonment of the ecologists and traditional farmers from the state of Guerrero, Rodolfo Montiel and Teodoro Cabrera, for which the Mexican State was condemned by the Inter-American Commission on Human Rights (IACHR, 2009).

- The murder of Mariano Abarca in the state of Chiapas on 27 November 2009. Abarca was a member of the "Dos Valles Valientes" organisation, a movement opposed to mining interests and a collaborator with the Mexican Network of persons Affected by Mines (Red Mexicana de Afectados por la Minería -REMA). (Frontline, 2009).

- The murder of Alberta "Bety" Cariño on 28 April 2009 in the state of Oaxaca, an activist who was part of the "Centro de Apoyo Comunitario Trabajando Unidos" (CACTUS) and the National Coordination Team of REMA. (Frontline, 2010)

- The murders of Leonel Castro Santana and Ezequiel Castro Pérez on 26 June 2009 in the state of Guerrero, who were part of the rural ecological organization "Organización Campesina Ecologista de la Sierra de Petatlán y Coyuca de Catalán" (Ocampo, 27 June 2009).

## Global and regional policy context

Mexico has sought to participate in various regional and international processes in the area of ICTs and climate change, as well as e-waste.

- Mexico ratified the Basel Convention in 1991.The objective of this Convention is to reduce the generation of hazardous wastes and the transboundary movements of this waste, as well as to assure its environmentally sound management. The Convention was adopted by the UN Plenipotentiary Conference on 22 March 22 1989.

- Mexico adopted the UN Framework Convention on Climate Change (UNFCCC) in 1992. The country is also part of the Kyoto Protocol; however as a developing country, it is not included in Annex 1 or in Annex B. In other words, it does not have a formal obligation— in this case — to reduce its GHG emissions.

- The North American Free Trade Agreement entered into effect on 1 January 1994. The Mexican government had persistently promoted this trade agreement despite social protest. At the time of the signing, and closely linked to the event, a strong indigenous protest, organized by the militarily, began in the state of Chiapas.

- Mexico has belonged to the Organization for Economic Cooperation and Development (OECD) since 1994. Within the OECD framework, Mexico is permanently invited to participate in the Group of Experts in Annex 1 of the Kyoto Protocol (Mexico and South Korea are the only members of the OECD not included in Annex 1). (SEMARNAT, 2009)

- The country has also been a member of the World Trade Organization (WTO) since 1995. Climate change per se is not part of the WTO's ongoing work programme. However, the WTO is relevant because climate change measures and policies intersect with international trade in a number of different ways.[9]

- In 1998 the Tampere Convention on the Provision of Telecommunication Resources for Disaster Mitigation and Relief Operations in the case of catastrophes was ratified. Unfortunately, Mexico has not signed this Convention.

- Since 1999, Mexico has participated in the Environmental Integrity Group (EIG). EIG shares an interest in assuring the environmental integrity of the global climate regime and is formally recognised as a negotiation group in the framework of the UNFCCC.

- Mexico actively participated in the World Summit for the Information Society (WSIS) process, in its two phases: Geneva (2003) and Tunis (2005), as well as in the global and regional preparatory meetings. Since that process, Mexico has been working in the regional strategy known as eLAC, which "conceives of ICTs as instruments for economic, and…social development", with a vision looking toward 2015, and in accordance with the Millennium Development Goals (MDGs) and with WSIS.

[9] http://www.wto.org/english/tratop_e/envir_e/climate_intro_e.htm

- Since September 2007, in response to a US government initiative, Mexico has been participating in the Major Economies Meetings on Energy Security and Climate Change. This forum has been taken up and modified by the new US administration, now under the name of the Major Economies Forum on Energy and Climate.

- In the arena of bilateral cooperation, Mexico maintains international cooperation links in relation to climate change with different countries, agencies, and international and regional entities. It has also signed a number of conventions on Clean Development Mechanisms (CDMs) with the governments of Germany, Austria, Canada, Denmark, Spain, France, Italy, The Netherlands, Portugal and with the Japanese International Cooperation Bank.

- In January 2008 the First Dialogue Meeting on the environment was held between Mexico and the European Union. Among the issues addressed at that meeting were climate change and sustainable production and consumption. An agreement was reached to form a special working group on these issues.

- In 2008 the Mesoamerican Strategy on Environmental Sustainability (EMSA) was signed. It was negotiated and agreed upon as a result of Mexico's work with the environment ministers in the region. Three areas are addressed: forests and biodiversity, climate change, and sustainable competitiveness. In relation to climate change, EMSA is planning initiatives in the following areas: reduction in vulnerability, adaptation measures, construction of low-carbon economic systems, knowledge development and building capacity.

- Mexico also participates in the Asian-Pacific Economic Cooperation (APEC) forum, in which climate change has also been addressed as a priority.

## National policy and legislative context

### *Digital policy instruments*

Despite the different initiatives for government actions and programmes, as well as other initiatives in Mexico's ICT sector, the country does not currently have a digital agenda (Hofmann, 2010; Piedras, 2010b). Mexico's Government Digital Agenda (Agenda de Gobierno Digital—AGD) is aimed at identifying the development strategy to be followed by the federal administration through the use of ICTs (AGD, 2008). Its strategy is based on co-ordination among the actors participating in the use of ICTs at the national level, seeking participation by different sectors. However a digital agenda The can be understood as a comprehensive set of long-term public policies based on ICTs and designed to contribute to economic and social development, improve the quality of education, increase transparency, increase productivity and competitiveness, and to create better government through greater citizen participation and commitment, as argued by Piedras (2010a).

Given this, the Mexican Senate, through its Science and Technology Commission, urged the executive branch of the federal government in 2010 to designate an entity that would be responsible for

developing an agenda for the country.[10] The Ministry of Communications and Transportation (Secretaría de Comunicaciones y Transportes), for its part, is promoting the creation of State Digital Agendas (Agendas Digitales Estatales) as part of its national "connectivity" programme (Hofmann, 2010), and industrial ICT and Telecommunications chambers of commerce such as AMITI, CANIETI and AMIPCI are also working toward a National Digital Agenda (Agenda Digital Nacional) to promote key areas of growth and competitiveness, greater investment in research and development, and to improve the legal context and government policies on ICTs.[11]

At one time, the National e-Mexico System, announced in 2000, was an important government initiative that generated great expectations in different sectors. Its objectives were too ambitious. Basically, its aim was to reduce the digital gap in Mexico, and the gap between Mexico and the rest of the world. One of the factors leading to its failure was precisely the absence of a digital agenda (Islas, Arribas, 2010).

In 2006 a number of companies dedicated to information systems made a proposal for their vision of Mexico in 2020, proposing recommendations for public policies in this regard. They pointed to the need for a digital agenda that reflects a long-term perspective and the suitable architecture of public policies for the adoption of ICTs in the country. The proposal of this business sector was to promote the development of the ICT sector with the aim of transforming it into an engine for economic growth, and implementing a legal framework for promoting unrestricted competition in the market (Visión 2020). That same year, AMIPCI presented a document entitled Agenda Digital de México (Mexico's Digital Agenda), in which the business opportunities generated by internet in Mexico were underscored (Islas et al., 2009).

More recently, the General Coordinating Body for the Information and Knowledge Society (Coordinación General para la Sociedad de la Información y el Conocimiento)[12] presented the "Digital e-Mexico Agenda, 2010-2012: A national strategy for promoting the information and knowledge society" (Agenda Digital e-México, 2010-2012. Estrategia nacional para el impulso de la sociedad de la información y el conocimiento). Once again the objectives proposed in this document are very ambitious. It attempts to strengthen mechanisms for co-ordination among public, private and social actors in order to promote a guiding national agenda; it seeks to intensify public investment in order to close the digital gap and guarantee universal access; it attempts to promote the building and strengthening of the capacities of Mexicans to manage technologies; and it attempts to generate mechanisms and models for orienting the use of ICTs toward social, economic and political development.

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[10] This bulletin can be consulted at: http://comunicacion.senado.gob.mx/index.php?option=com_content&task=view&id=17431&Itemid=80

[11] http://www.cysp.com.mx/Ima/Amiti/Documentos%20Descargables/ADN_Inicio.html

[12] In 2009 the National e-Mexico System became the Coordinating Body for the Information and Knowledge Society.

It is important to note that no reference is made in any of the documents and initiatives mentioned regarding the use of ICTs in confronting the challenge of climate change, or in dealing with e-waste.

***Environmental policy instruments***

According to De León (De León in Greenpeace, 2010) we are observing a slow but important pendular movement of concepts and institutional responses in Mexico, a certain conceptual and operational migration in relation to the environment and the issue of climate change. Despite the progress made in some areas, experts agree that Mexico needs to consolidate a global strategy that coordinates the set of actions and public policies oriented toward mitigating and adapting to climate change (Galindo).

Mexico signed the UNFCCC in 1992, and ratified it in 1993. It signed the Kyoto Protocol in 1997, and ratified in 2000. Since the UNFCCC went into effect in 1994, and the Kyoto Protocol in 2005, they have formed part of Mexico's legislation, based on Article 133 of the National Constitution[13] (SEMARNAT, 2009).

Regarding the formulation of national or regional programmes for mitigating climate change and facilitating adaptation to its adverse effects, Mexico produced a document called Strategy for 2000 (Estrategia en 2000). In 2007 the National Strategy on Climate Change (Estrategia Nacional de Cambio Climático—ENACC) was presented (SEMARNAT, 2007). It was here established that climate change in a matter of national security: a statement that is considered fundamental to the construction of adaptation policies at the national level (Conde, 2009).

Based on ENACC, the Inter-sector Commission (Comisión Intersecretarial) developed a Special Programme on Climate Change (Programa Especial de Cambio Climático—PECC) 2008-2012. PECC includes four fundamental components for developing a comprehensive policy for confronting climate change: Long-term vision, mitigation, adaptation, and elements of cross-cutting policy (public policies, inter-sectorial and inter-institutional actions).

Actions in response to climate change are gaining strength in Mexico. Besides the federal level, a number of states are also developing state-level laws on climate change. In 2010 laws were finalized in Veracruz, Mexico City (Federal District) and Chiapas. Other states working to finalize their own laws or develop action plans include Nayarit, Durango, Baja California, Sonora, Nuevo Leon, Guanajuato, Michoacan and Quintana Roo. Regional plans are also being established, as in the case of the Yucatan peninsula (including the states of Yucatan, Campeche and Quintana Roo). So far a strategy for adaptation to climate change and the creation of a regional fund for climate action have been developed.

[13] Article 133 states basically that "This Constitution, national Congressional legislation emanating from it, and all the Agreements in accordance, passed and which are passed by the nation's president, with Senate approval, will become part of the Supreme Law of the Union."

Mexico City (Federal District), as the country's capital, and due to its economic and political importance and the size of its population,[14] plays a strategic role in actions carried out around the country in response to climate change (AACM, 2007). In 2006 the Mexico City government developed its Local Strategy for Climate Action (Estrategia Local de Acción Climática—ELAC). This strategy harmonized various actions from the 2002-2006 Mexico City Environmental Protection Programme (Programa de Protección Ambiental del Distrito Federal 2002-2006) developed by the Ministry of the Environment, particularly the 2002-2006 Programme for Improving Air Quality in the Metropolitan Area of the Valle de México (Programa para Mejorar la Calidad del Aire de la Zona Metropolitana del Valle de México 2002-2010—PROAIRE), the Mexico City Program for Ecological Restoration of Soil Conservation (Programa de Restauración Ecológica del Suelo de Conservación del Distrito Federal), and the Mexico City Transportation Program (Programa de Transporte y Vialidad de la Ciudad de México (PITV 2001-2006). For the first time the basic lines for adaptation were established in the ELAC, to be followed by Mexico City in response to effects from climate change (ELAC, 2006).

Mexico City also has a Mexico City Environmental Agenda: 2007-2012 Environment Programme (Agenda Ambiental de la Ciudad de México. Programa de Medio Ambiente 2007-2012), with a particular section on solid waste and another on climate change and energy. More recently (2010), the Environment Commission of the Mexico City Legislative Assembly has backed a new law on climate change that will very likely be approved in its totality. Included in this proposal are adaptation and mitigation actions for the short, medium and long-term. It attempts to: develop a climate monitoring system and early warning mechanisms; estimate the effects from future climate change scenarios; calculate the necessary investment for adaptation and risk reduction; and encourage citizen participation, to mention some of the components.

### *E-waste*

Mexico has developed a series of legal provisions at the federal level that constitute a general legal framework for waste management under a policy known as Prevention and Sound Management of Waste. This framework includes the General Law for Ecological Equilibrium and Environmental Protection (Ley General para el Equilibrio Ecológico y la Protección al Ambiente), the General Law for Prevention and Sound Management of Wastes and their Regulations (Ley General para la Prevención y Gestión Integral de los Residuos y su Reglamento), as well as the Mexican Official Standards (Normas Oficiales Mexicanas).

Waste from the production and use of electronic devices is considered waste requiring special handling and its regulation falls under state and municipal jurisdiction. Regulations at these levels are only beginning to be established, or existing regulations are only currently being reviewed in order to

[14] By 2005, according to official stastics, Mexico City had a total of 8,720,916 inhabitants, not counting the population in the greater metropolitan area.

include the corresponding provisions. This is different to other hazardous wastes, which fall under federal jurisdiction.

Data available on the generation, handling and storage of e-waste is minimal and incomplete. One figure that some authorities and environmental groups seem to agree on is that 300,000 metric tons of waste are generated a year, with an annual growth rate of 6% (Méndez, 2011). It is important to acknowledge, however, that there are many difficulties in quantifying e-waste. For instance, many electric and electronic products are stored in homes or in shops at the end of their lifecycle (González Llera, 2004).

A number of the initiatives for collecting and disposing of e-waste exist in the private sector. E-waste is, perhaps as a result, not generally found on the country's landfills. However, it is not generally known where the e-waste generated is going.[15] (Moguel, 2008; UNEP, 2009).

With regard to waste special handling, legislation emphasizes the creation of markets for by-products or derived products (lead, cadmium, silver, etc.) that are generated due to various recycling processes. This encourages private capital to invest in the development of these markets, as well as minimizing the extraction of natural resources. Nevertheless, these efforts are not connected or co-ordinated with other green government efforts, such as those aimed at the reduction and savings in energy consumption.

This policy has encouraged the establishment and creation of firms that organise campaigns for collecting previously sorted e-waste for treatment and decomposition, and sourcing metals with a high value on the market. However, the policy does not propose specific measures for the reduction of waste production (which is why production figures continue to rise, according to the National Institute of Ecology), far less reduce the speed of the extraction-production-consumption-waste cycle.

There are reports in the Mexican media on activities in some cities to collect waste, generating isolated data on what is collected through the "reciclotones" (recycling campaigns) carried out through coordinated efforts between companies and local governments. One such example is the first "2010 Guadalajara Recycling Campaign" that managed to collect 51.3 metric tons of e-waste that was re-used and disposed of by the Recicla Electrónicos México company (Remsa) (Informador.com.mx, 2010).

[15] Communicated directly by Dr. María Concepción Martínez, researcher at the Interdisciplinary Center for Research and Studies on the Environment and Development, CIIEMAD.

***National Development Plan as a guiding focus of public policy in Mexico***

The country's sector-based programmes are derived from the National Development Plan (NDP). The current NDP in Mexico is the one covering the period from 2007 to 2012. The current structure of the plan has five sections that correspond to the five areas of public policy:

- Rule of law and security.
- A competitive, job-creating economy.
- Equal opportunities.
- Environmental sustainability.
- Effective democracy and responsible policies.

ICTs are reflected differently in each particular area. In the case of "rule of law and security", the NDP emphasises the use of these tools for exchanging audio, video and text data, and for interconnecting the information systems of police forces, with the objective of consolidating high-technology information systems such as the Single System of Criminal Information (Sistema Único de Información Criminal). The objective is to facilitate investigations, joint operations, and police intelligence. This is an area in which ICTs are being used a great deal in Mexico.

The 2007-2012 National Development Plan defines a strategy for elevating productivity and achieving a competitive, job-creating economy (the second area in the NDP). The Plan states that "the adoption and development of new technologies makes it possible to produce new goods and services, and to enter into international markets". The strategies for promoting the productivity and competitiveness of the national economy include: the possibility of developing programmes that assist workers and their families in entering the information and knowledge society; facilitating scientific research, technological innovation for increasing productivity, favouring the introduction of capital goods and inputs; and designing sector-based agendas for the competitiveness of areas of the economy characterized by high aggregate value and high technological content.

In the same area of "a competitive, job-creating economy", there is also mention of increasing access to telecommunications services by increasing competition among those granted concessions; increasing the coverage of satellite and cellular telephony services; and promoting the development of the technological infrastructure for connectivity. The NDP also refers to promoting financing and self-sustainability schemes for the use of ICTs in projects, and urging greater investment for creating infrastructure and providing telecommunications services. Finally, it seeks to modify study programmes for the purpose of increasing productivity and competitiveness.

In the "equal opportunities" area, the NDP seeks to provide more computers, fight digital illiteracy, promote long-distance educational models, support connectivity in schools, libraries and homes; and modernise the educational system by incorporating technological teaching-learning platforms.

For the first time the NDP explicitly incorporates the issue of climate change (PECC, 2008). Nevertheless, in the "environmental sustainability" area, there is no explicit mention of actions or recommendations linked to ICTs, even though a number of actions in which the use of ICTs would be fundamental were addressed. Some examples are scientific research or the intention to "promote the dissemination of information on the impacts, vulnerability and measures for adapting to climate change" (NDP, 2007).

Regarding the fifth area identified as "effective democracy and responsible foreign policy", the NDP contemplates the systematisation and digitalisation of all administrative procedures and the use of ICTs for public administration. It promotes communication among government officials, and between government officials and citizens. It seeks to facilitate access to information, promote transparency and promote the use of ICTs in managing documents.

### *Components of actions in response to climate change, including public policy documents referring to ICTs*

In the following section we will attempt to use the components proposed by Ospina (2010) in her "General Model on ICT, Climate Change and Development" (Modelo General sobre TIC, Cambio Climático y Desarrollo) to group the different topics found in public policy instruments in which, from the viewpoint of this study's authors, ICTs should be used and should result in a certain impact. It is important to mention that explicit references to ICTs are not found in public policy planning, with the exception of the National Civil Protection Programme.

### *Strategy*

Conde (Conde, 2010) refers to the importance of direct intervention on the part of those who will be possibly affected by climate change in defining and managing national and/or regional strategies. Nevertheless, clear proposals on participation by those affected and other sectors of civil society cannot be found in federal plans and regulations related to climate change, with the exception of communication plans.

It can be observed in legislation that the communication area becomes important to the degree that communication plans are indicated. For example, the Special Programme on Climate Change (Programa Especial de Cambio Climático—PECC) proposes the goal of formulating and implementing

the communication strategy for the PECC programme. However, concrete mechanisms or means are not mentioned, and consequently, the possibility of implementing these initiatives through ICTs is very uncertain and quite possibly non-existent.

Another example can be found in the Veracruz State Law on Mitigation and Adaptation to Climate Change (Ley Estatal de Mitigación y Adaptación ante el Cambio Climático de Veracruz). There is reference in this law to creating operational committees and sub-committees composed of representatives of government offices, for the purpose of studying, consulting, analysing, communicating and co-ordinating in the area of climate change. Still another example is the Mexico City Environmental Agenda (Agenda Ambiental de la Ciudad de México), which includes a project for communication and dissemination aimed at communicating climate change risks to the population, and developing programmes for the communication of risks among the population.

Nevertheless, legislative instruments do not generally speak of any particular mechanisms or means for carrying out these actions, and if they do, they refer to mass communication media. This is the case for the education and training programme also presented in the Mexico City Environmental Agenda, which seeks to establish the guidelines for information, communication and training actions by various government offices, as well as to develop an educational communication strategy through the use of mass media (AACM 2007).

Finally, particularly in the case of Mexico City, we find diverse actions associated with strategies, referring particularly to citizen consultations. Citizen participation is contemplated in the new Mexico City Law on Climate Change, through plebiscites, referendums, popular initiatives, citizen consultations, networks of citizen watchdogs, public hearings, and citizen assemblies. (SMA, 2010 )

***Monitoring***

Internet is moving beyond mass communication media to become the most important social channel for scientific discussion (Belme, undated). According to the interviews conducted with Mexican researchers, we can say that ICTs are clearly being used by environmental scientists. These technologies are unquestionably a fundamental source for capturing and processing data, as well as for disseminating information among this sector. It is important to note that ICTs have not, however, been enough on their own to guarantee the presentation and dissemination of scientific information to other sectors of society.

The following objectives are identified in the PECC. They are potentially linked to ICTs and may be grouped in this monitoring category:

1. Report 80% of national GHG emissions from generating and using energy and industrial processes to the programme.

2. Provide scientific research to support the preparation and publication of a National Atlas on Vulnerability to Climate Change.

3. Implement a comprehensive national system for hydrometerological observation.

4. Conduct research that contains estimates on national factors of GHG emissions by way of solid urban wastes.

5. Implement a national system for monitoring and reporting the distribution, abundance and dynamics of vegetation cover.

6. Implement a national system for monitoring and reporting the status of soil and the degradation of lands.

7. Conduct three sector-based and regional studies on technologies and technological improvements for mitigation in key sectors.

The Veracruz Law on Climate Change proposes the publishing of an annual report on emissions levels for greenhouse gases in the state, as well as actions taken by the state government in the areas of adaptation and mitigation. There is also the intention of "designing and implementing a Climate Modeling Program and Climate Information System, as well as contributing to a State Atlas on Risks (Gobierno Veacruz, 2010)

***Mitigation***

Mexico has proposed in many documents and forums its goal of reducing its GHG emissions by 50% by 2050 compared to its emissions levels in the year 2000. The country therefore aims to contribute to achieving a level that is below 450 parts per million of equivalent carbon dioxide. (PECC, 2008, viii).

In PECC we see the need to create an effective mitigation strategy that should include the identification of innovative technologies, the strengthening of mitigation and adaptation technologies available in the market, and the necessary incentives for their development, while at the same time promoting the development of clean technologies (PECC, 2009). It is important to mention that while there is a recognition that technologies are important tools for reducing GHG emissions, ICTs are not presented as active agents in the mitigation actions in the material reviewed.

We know that the transformation to a more digital society is leading to a need for more electronic equipment that uses more energy, mostly electricity (Telefónica, undated). While it is pointed out in the PECC that "activities that generate GHG can only be transformed through cultural changes, capacity building, technological developments and institutional modifications," it also acknowledges that these transformations are complex and require time, dedication and perseverance, in addition to the political will to carry them out (PECC, 2008). To diminish the carbon footprint, discussions between society and government on the double effects of ICTs are necessary. On the one hand, regarding the negative impacts generated during their production,[16] their operation and their disposal, and on the other hand, regarding their positive impacts, as useful tools in mitigation, adaptation and monitoring measures.

It is also acknowledged in the PECC that "the mitigation effort proposed by Mexico requires a profound transformation in forms of production and consumption of energy use" (PECC, 2008). It is therefore necessary to discuss a decrease in consumption rhythms, as well as a revision of models of growth, development and well-being. While these reflections are discussed by civil society organisations, few deliberations on the issue are held by Mexico's politicians.

The federal government proposals closest to provoking cultural changes for diminishing GHG are advertising messages that promote energy savings ('turn out the lights', for example), such as those paid for by the National Commission for Energy Savings (Comisión Nacional para el Ahorro de Energía). In 2008 the latter changed its legal status and its name to the National Commission for the Efficient Use of Energy (Comisión Nacional para el Uso Eficiente de la Energía).[17] Some examples of their audiovisual messages can be found at http://www.youtube.com/user/conueemx[18]

With the promotion and increased application of practices such as minimisation, re-use and recycling of wastes, we can expect a mitigation effect of approximately 83 MtCO2e by 2030, with a negative or very low cost (PECC, 2008).

[16] To exemplify the heightened carbon footprint signified by the manufacture and use of ICTs, we can borrow a quotation from Telefónica de España: "In the manufacture of a single tabletop PC, at least 240 kg of fossil fuels are used, equivalent to ten times its own weight." (5) (Telefónica)

[17] The International Energy Agency considers the use of electronic equipment that is turned on but not being used as responsible for between 5 and 10% ot the total consumption of electricity in most householdsk and an undetermined percentage in offices, businesses and factories, representing 1% of the global emissions of carbon dioxide. (6)

[18] It is important to note that in the fourth National Inventory of Greenhouse Effect Gases (Inventario Nacional de Emisiones de Gases de Efecto Invernadero—INEGEI) the energy category is the main source of emissions, followed by the waste category.

***Adaptation***

Mexico places the same importance on the tasks of adaptation to climate change as to those of mitigation of GHG emissions (PECC, 2008).

Adaptation is identified in the PECC as having the following results: the strengthening of individuals' capacities, their properties, infrastructure and ecosystems, and the development of comprehensive risk management.

The perspective presented in the PECC considers three major stages:

*The stage of the evaluating vulnerability, and the economic assessment of the priority measures for 2008-2012.* The priority measure will be the design of a comprehensive system of adaptation. The components closest to the ICTs are:

- Publication of the National Atlas of Vulnerability to Climate Change (developed on the basis of the Atlases already produced by various institutions);
- Publication of a Proposal for Modification to the National Civil Protection System, with a perspective of comprehensive risk management;
- Publication of Studies on the Economic Implications of Climate Change in Mexico, and the integration of their recommendations in the formulation of sector-based public policies.

*The stage of strengthening specific capacities, 2013 - 2030.* Includes the following as possible elements linked to ICTs:

- Eradication of policy instruments that serve as an incentive for environmental deterioration and GHG emissions; and
- Evaluation and application of public policies on climate stability and the environmental sustainability of development.

The last stage proposed is focused on the *consolidation of the instruments developed between 2031 and 2050* (PECC, 2009). No direct link with ICTs can be observed.

***Prevention and early warning***

Another aspect is the significant role played by telecommunications, for some years now, in the success of the prevention and early warning[19] of natural phenomena (Telefónica), as well as in the co-ordination of tasks for providing assistance to those left homeless. The issue of climate change, according to De León, is being transferred from environment entities to civil protection entities (De León in Greenpeace, 2010). Mexico is one of the countries in which systemic vulnerability associated with endemic poverty exacerbates the intensity of the needs that arise when there is a natural disaster (Ospina, 2010). As a result, it is particularly relevant in Mexico that ICTs are taken into consideration in the significant work necessary for the preparation of early warnings. In the 2008-2012 National Civil Protection Programme, there are clearer references to ICTs, mentioning:

1. The use of technological tools and information systems to achieve better coordination among the members of the National Civil Protection System, and to work more closely with the population;
2. Technological infrastructure and modern digital systems of standardised information that serve as support instruments for effective management of processes and decision-making;
3. The National Communications Center converted into a technological and telecommunications platform that makes it possible to obtain information for timely decision-making and warnings for the entire country;
4. Databases and statistical tools for obtaining the information that will make it possible to calculate and prevent emergency and disaster situations;
5. Technologies for monitoring and early warnings on disturbing phenomena;
6. Geospatial information on dangers, vulnerability and risks, to be integrated into the National Risks Atlas;
7. Addition of the South-Southeast chapter of the Mesoamerican Atlas of Natural Threats;
8. A comprehensive system of information for improving the coordination and operation of the National Civil Protection System; and
9. A National Volcanological Monitoring System.

[19] An early warning system is a system that collects information and that is able to warn of threatening situations on the basis of constant monitoring. It should be effective enough to predict likely crisis situations ahead of time, and simultaneously allow for making appropriate responses. Textual quotation on page 12 of the report.

# 8. Findings and analysis

Mexico, like most of the world, is experiencing a transformation oriented toward the digitalisation of society that leaves its mark on everyday life, social processes and strategies for organising various fields of contemporary society. The environment feels the impact of ICTs. However, ICTs are not reflected in Mexican environmental policy, nor is the environment reflected in the ICT national agenda.

In Mexico, there is very little recognition of ICTs, both in terms of their negative impact, for example, by being part of energy consumption and thereby contributing to GHG production, and in the positive sense that positions them as allied tools for mitigating and dealing with the effects of this threat.

An enormous amount of work carried out by Mexico has been included in documents, proposals, official reports submitted to UNFCCC, plans and national action strategies for dealing with climate change. These materials, however, barely refer to ICTs as tools for dealing with climate change. ICTs mainly appear in these documents in a non-explicit fashion. The ICT sector is omitted in the reports and official briefs linked to climate change.

At the same time, there is a very weak link between the country's digital strategies and environmental strategies involving climate change. Public policies in the two fields do not overlap. As a result, Mexico is experiencing the gap identified by Ospina (Ospina et al., 2010), since ICTs, with all their potential, are becoming disconnected from policy-making processes and climate change strategies. Because of this, the danger posed by the gap in public policies regarding pushing ICTs towards the "clean" or "intelligent" categories oriented toward coping with climate change, raises the risk of placing Mexico in the least favorable part of the "mitigation divide" (Ospina et al., 2010) – and this with the threat of broadening the digital divide. This is particularly likely since increasingly robust trends are emerging in the North, such as the promotion of public policies for the dematerialisation of work, transport systems and intelligent construction, to mention just a few.

However, on the basis of interviews and the review of official materials, governments can be said to be using ICTs to communicate, draw up documents, discuss, propose and disseminate strategies. Civil society organisations also use them as a means for meeting their communication needs in a strategic sense and to achieve organisational co-ordination and the dissemination of their information.

In Mexico, ICTs have an obvious capacity for facilitating the establishing and functioning of networking. Work in civil society networks can be observed around civic demands and social movements as a response to unfair socio-economic conditions, exacerbated by floods, droughts, the destruction of ecosystems and agrosystems, soil degradation and other environmental changes linked to climate change. However, continuous dialogue with systematised results between the members of civil society and governments or other actors is not facilitated by the use of ICTs (according to interviews carried out with various political actors in the environmental sphere).

ICTs are heavily used by academic and research sectors. The country has various studies, projects and on-going research on climate change conducted by both universities and national research centres

that use telemetry tools, GPS and other types of technology to measure and analyse (in addition to using ICTs to facilitate communication and education processes and other processes for boosting skills). However, besides the results of studies conducted, the use of these tools is quite remote from citizens and not reflected in public policy instruments.

There is no record in official documents such as policy documents, plans and programmes of criticism of the predominant model of ICT consumption in contemporary society. Actual models derived from the global market model mean high green house gass production levels. This means that there are no initiatives encouraging society to reduce high, irrational and imbalanced consumption of technological products by part of the population.

Ospina et al. (2010) state that climate change has different effects depending on the degree of exposure and susceptibility of the various contexts, where equity is a key issue. Mexico has enormous heterogeneity (León, 2010), which means differences between municipalities, rural and urban zones, the north and south and the coast and mountains, to name just a few. Different levels of access to ICTs is another of the expressions of economic and social inequality in Mexico. Without universal access, it is impossible to guarantee the proper use of ICTs in actions to cope with climate change. The demand for universal access and connectivity therefore becomes an essential condition for the necessary actions of monitoring, adaptation, mitigation and strategy in Mexico. Universal access to ICTs is therefore seen as a priority among the various challenges to be met, not only within the sphere of capacity building in broad regions of the country, where educational indicators barely achieve basic levels, but also for dealing with the high internet connection costs and the intermediation characterising computer technology distributors, whose share of the market makes software and hardware between 50% and 100% more expensive than comparable prices in the US. These problems must be resolved without contradicting a sustainable model of production, consumption and waste entailed by the production of low levels of green house gasses.

Certain are relevant to these statements:

1. There is no digital agenda to promote or regulate the ICTs used for actions to combat climate change or for health, housing, the environment, education, water, energy or food security.
2. There are no proposals or plans for the use of ICTs based on public policies for health care in the event of an emergency as a result of climate change.
3. The various proposals for a Digital Agenda do not consider the issue of climate change or the need for actions to cope with them. Nor do they consider them in the creation of sector-based programmes for ICT use. Another gap involves the proposal of measures to use these technologies in an environmentally sustainable way in terms of reducing one's carbon footprint.
4. There is also no evidence of the use of ICTs linked to actions for dealing with climate change in the Digital Agenda. This Agenda is important since it seeks to coordinate ICT use at all levels of the country's public administration.

5. Although certain official institutional websites provide energy consumption calculators or general information on climate change, there are no spaces for creating collective actions to respond to the situations caused by this.
6. There are also no mass media campaigns launched in civil society networks or drawn from official sites that encourage civic participation in highly interactive spaces as happens in other parts of the world.
7. The use of ICTs that appears in official public policy documents and information systems mainly involves public security and the country's intelligence systems.

However, the existing gap in the overlap between ICTs and climate change, in other words, between environmental and digital agendas may be due to one or more of the following reasons:

1. No digital agenda as defined in this report has been achieved to date in the country. Mexico does not have a "legal, normative or regulatory framework that it sufficiently reliable for all actors and capable of governing the Digital Strategy and therefore coordinating the programs comprising the Digital Agenda" (Hofmann, 2010).
2. There is no practice of interlinking public policies in Mexico.
3. Official communication strategies are often generated from top to bottom and from the outside to the inside (León, 2010).
4. Public policy creation and management in Mexico involve very little participation from civil society and other sectors of society, which restricts the capacity for vision, diversity and action.
5. Public policy decisions are made in an isolated fashion with insufficient information for sustaining them and with no clear procedures for measuring performance or ensuring accountability (Hofmann, 2010b).
6. Mexico has a low awareness of the need to reinforce the information society.

Without the necessary planned integration of ICTs into strategies for and monitoring, mitigating and adapting to climate change, Mexico is missing many opportunities, including:

1. The possibility of dealing with the problem of climate change and developing a strategy for monitoring, mitigating and adaptation simply, efficiently and widely.
2. Supporting communities affected by climate change, legislators, activists and civil society, with information that will assist in their participation in processes of dialogue and decision-making.
3. Facilitating the processes for reaching agreements between multi-stakeholders. One example is the co-ordinated planning of official medium- and long-term strategies for dealing with emergencies.
4. The possibility of boosting co-ordination efforts to plan and implement actions between political, scientific and civil society communities, particularly between communities of those who have been affected. This is especially the case if other systems and communication networks guaranteeing an effective information flow and which permit dialogue between the various parties are not constructed. It goes without saying that communication needs will be more complex and multiplied by the migratory movements, both within the country and to the US, of those affected by climate change.
5. The possibility of interaction among communities of affected persons to exchange knowledge, experiences and plan actions. It is important to mention the need to respect ways of reproducing communities' traditional knowledge by attempting to ensure that ICTs have a positive effect on the mechanisms for reproducing this knowledge.
6. Increasing the creation and strengthening of individual, community and institutional skills within the same logic of not destroying the reproduction of traditional knowledge and customs.
7. The above in addition to so many possible strategy, monitoring, mitigation and adaptation actions, such as the dematerialisation of work, early warning systems, and transport and intelligent construction systems that have already been widely discussed by specialists.

Regarding e-waste, it needs to be pointed out that since there is no accurate information available in Mexico on the details of the final disposal of e-waste, there are no accurate records of e-waste quantities. There are very few studies available on this subject. However, this is closely linked to high and imbalanced consumption patterns in the country, which need to be addressed. There is also a need to continue to review the agendas, public policy initiatives and strategies implemented in Mexico regarding the cross-cutting use of ICTs, their production and disposal, and their potential to be used in the mitigation and adaptation to climate change.

What kind of production, consumption, use and waste processes are best for the environment and sustainable society? Is it possible to promote this analysis in Mexico and propose measures that will have an impact on the country's public policies? This is a task that corresponds to the research, management and planning sectors, decision-makers, the communities affected and obviously society as a whole. The analysis must also consider the challenges and opportunities related to the entire process involving ICTs within the environmental framework. It is necessary to use studies in other countries on the use of ICT equipment as a reference and contrast them with the national situation to determine the viability of using them and create public policies in Mexico regarding this issue.

## 9. Advocacy opportunities

Some sectors of Mexico's civil society might be interested in participating in advocacy efforts aimed at insuring that ICTs are produced, consumed, used and disposed of in an environmentally and socially sustainable manner. Organisations may be interested in seeing that ICTs are used with a social focus in the mitigation of and adaptation to climate change, as well as in action and monitoring strategies, with the aim of turning these proposals into national public policies. In this framework, it is important to:

1. Guarantee, through observation, follow-up and action, the adoption of public digital policies at the national level that are coherent with the country's and the planet's environmental sustainability. Specifically, public policies that contemplate the promotion of fair, rational and sustainable models of production, consumption and disposal of ICTs are important.
2. It is also critical to work toward public polices oriented towards guaranteeing universal access to ICTs and the internet, and accessible fees for broadband and other services, such as cell phone connectivity. In this way, favorable conditions can be created for populations and governments to use ICT equipment in actions addressing climate change.
3. Seek public policies that include programmes for the production, assembly, re-use and recycling of ICT equipment, assuring conditions that protect the health of consumers and workers.
4. Work to guarantee that adaptation, mitigation, strategy and monitoring measures do not contradict or fail to respect the means and forms of communication used in communities (oral traditions and community radios, for example). ICTs may instead complement these communication processes. It is fundamental that communities participate in these processes on the basis of their own realities.
5. Assure processes of communication and dialogue with authorities through the use of ICTs, which, together with other means of interaction, facilitate and promote citizen participation at the local level in the planning of public policies (including civil protection plans) and accountability.
6. Continue to promote the creation of national and local networks of civil society through the use of ICTs. This should be done through action strategies in response to events produced by climate change such as flooding, hurricanes, loss of harvests, rising river levels, etc.
7. Work toward creating a registry of the experiences of Mexican communities that have suffered the manifestations of climate change. ICTs are an ideal tool for doing this. The registry and systematisation of lessons learned can support future strategies.
8. Work toward transparency on the process of extraction, production, and marketing of ICT equipment and subsequent e-waste management. Also important is the information on

manufacturing companies, importers, distributors and recyclers, and the life cycles of brands and models in order to have detailed data for the creation of a National Inventory of Electronic Waste.

9. Generate actions for guaranteeing capacity building around sustainable use of ICTs, involving greater responsibility in forms of production and consumption, for both producers and consumers. ICTs and other means of communication can be used for this.
10. Establish an observatory for monitoring the implementation of sustainable processes for regulating ICTs at the international level. One example is the recent recommendation from the ITU on universal chargers for cellular phones to allow users to use the same cellular charger for different models (ITU, n.d.). Another example is to make progress in developing hardware and software that will fulfill higher standards in saving energy—in both production and consumption—and in promoting longer periods of use (regulations that discourage practices leading to short-term obsolescence, and that encourage the design of long-lasting products).

## 10. References


Asomoza, R.(n.d.). Marco Jurídico y Políticas Públicas para el Desarrollo de la Sociedad de la Información. Ponencia presentada en el Foro Una Agenda Digital para Transformar a México. Senado de la República. México: CINVESTAV. http://www.senado.gob.mx/comisiones/LX/cyt/content/cuadros/agenda_digital/docs/Rene_Asomoza.pdf

Bermeo M, Doria (n.d.) El Cambio Climático en la Sociedad de la Información y el Conocimiento Frenando el cambio climático en la web2. Barcelona: Internet Interdisciplinary Institute (IN3).

CANIETI. (2004a). Instrumentación del Programa de Competitividad de la Industria Electrónica. Vol. II Estrategia y Plan de Acción. Cámara Nacional de la Industria Electrónica de Telecomunicaciones e Informática. http://www.canieti.org/assets/files/434/Estudio_Electronica_Final_Vol_II.pdf

CANIETI. (2004b). Instrumentación del Programa de Competitividad de la Industria Electrónica. Vol. I Análisis del Sector y Áreas de Oportunidad. Cámara Nacional de la Industria Electrónica de Telecomunicaciones e Informática. http://www.canieti.org/assets/files/434/Estudio_Electronica_Final_Vol_I.pdf

CEREAL (2009). Derechos laborales en tiempo de crisis. Tercer informe sobre condiciones laborales en la industria electrónica de México. Mexico: Centro de Reflexión y Acción Laboral (CEREAL).

CIAPEM, (2010). Plataforma México, una moderna red informática. Comité de Informática de la Administración Pública Estatal y Municipal A.C. Mexico. http://www.ciapem.org.mx/noticias-ciapem/gobierno-federal/130-plataforma-mexico-una-moderna-red-informatica

CMNUCC (1992). Convención Marco de las Naciones Unidas sobre el Cambio Climático. . FCCC/INFORMAL/84 GE.05-62301 (S) 220705. Nueva York: Naciones Unidas.

COFETEL (2010). Comisión Federal de Telecomunicaciones. Website. http://www.cft.gob.mx/

Covarrubias, J. (2010, 26 July). Trabajadores de la industria electrónica demandarán a empresas por violar la ley. LaJordana Jalisco. http://www.lajornadajalisco.com.mx/2009/06/26/index.php?section=politica&article=007n1pol

De la Peña, H. (2010). Científicos sacan cuentas con miras al 2011. Investigación y Desarrollo. ID.

Damman, G. (2008). Sistemas de información y alerta temprana para enfrentar al cambio climático. Lima: Soluciones Prácticas-ITDG.

Estrada, J. (2 July 2009) Obreros exigen que IP transparente utilidades. Milenio online. http://impreso.milenio.com/node/8585232

Front Line, (2009). México: asesinaron al Sr. Mariano Abarca Roblero, defensor de los derechos humanos. Website Front Line: http://www.frontlinedefenders.org/es/node/6252

Front Line, (2010). Mexico: Human rights defender Ms Bety Cariño tragically killed in violent paramilitary attack in Oaxaca. Website Front Line http://www.frontlinedefenders.org/node/2478

Galindo, L.M (Ed). (2008). La Economía del Cambio Climático. México, versión preliminar. México: UNAM.

González Amador, R. (2007, February 23). Telmex: en el mercado y no en tribunales, la competencia en las telecomunicaciones. LaJornada. http://www.jornada.unam.mx/2007/02/23/index.php?section=economia&article=023n1eco

Gonzalez Llera, R. (2004). Integrated Electronic Waste Management in Mexico: Law, Technology and Public Policy. ITESO, MIT, http://dspace.mit.edu/handle/1721.1/17717?show=full

Graizbord, B, Gonzáles, R. González J. L. (2010). Migraciones y Cambio Climático. In Greenpeace, México ante el Cambio Climático. Evidencias, impactos, vulnerabilidad y adaptación (pp. 19-23). Mexico: Greenpeace

Greenpeace (2010). México ante el Cambio Climático. Evidencias, impactos, vulnerabilidad y adaptación. México: Greenpeace.

Hofmann, A. (2010, December). Agendas digitales: ¿calenturas bicentenarias?'. Política Digital Innovación Gubernamental. Retrieved January 4, 2011 from http://www.politicadigital.com.mx/?P=leernoticia&Article=20656

Hofmann, A. (2010b). Una agenda digital para transformar México. Ponencia presentada en el Foro Una Agenda Digital para Transformar a México. Senado de la República. México: Política Digital Innovación Gubernamental.

IACHR, (2009). Application to the Inter-American Court of Human Rights in the case of Teodoro Cabrera García and Rodolfo Montiel Flores (Case 12.449) against the United Mexican States. Junio 24.Inter-American Commission on Human Rights: Washington.

Ingram Micro (2010). Boletines de Prensa, 20 de enero 2010. http://www.ingrammicro.com.mx/corporativo/250110.asp

ITU (2010). Medición de la Sociedad de la Información 2010. Geneva: International Telecommunications Union (ITU).

ITU (n.d.). Propiciar un futuro con bajas emisiones de carbono: el papel esencial de las TIC para abordar el cambio climático. http://www.itu.int/net/pressoffice/backgrounders/itu/12-es.aspx

Islas, O. Arribas, A. (2010, May) La Agenda Digital Propuesta por la Coordinación General de la Sociedad de la Información y el Conocimiento. Etcétera no. 114.

INEGI (2010). Censo de Población y Vivienda. Resultados preliminares. México: Instituto Nacional de Estadística Geografía e Informática. Web site of INEGI. Retrieved February 2011.

Informador.com.mx (2010a). Romero Hicks reflexiona sobre la investigación científica en México. Informador.com.mx. http://www.informador.com.mx/tecnologia/2010/251970/6/romero-hicks-reflexiona-sobre-la-investigacion-cientifica-en-mexico.htm.

Informador.com.mx (2010b).Recolectan 51.3 toneladas de residuos electrónicos.Informador.com.mx. http://www.informador.com.mx/jalisco/2010/217829/6/recolectan-513-toneladas-de-residuos-electronicos.htm

LaJornada, (12 December, 2010). Conferencia de las partes de la Ocnvención de la ONU sobre Cambio Climático. LaJornada Morelos. http://www.lajornadamorelos.com/opinion/articulos/93812-conferencia-de-las-partes-de-la-convencion-de-la-onu-sobre-cambio-climatico

León, C. Magaña, V. Guigue, L. (2010) La adaptación al Cambio Climático: ¿de quién o para quién?. Siete argumentos para un manual. In Greenpeace, México ante el Cambio Climático. Evidencias, impactos, vulnerabilidad y adaptación (pp. 57-65). Mexico: Greenpeace.

Mares, M. (2010, July 28) ¿Concentración en telecomunicaciones? El Economista.mx http://eleconomista.com.mx/columnas/columna-especial-empresas/2010/07/28/concentracion-telecomunicaciones

México. Comisión Intersecretarial de Cambio Climático. (CICC). (2009). Cuarta Comunicación Nacional ante la Convención Marco de las Naciones Unidas sobre Cambio Climático. México: CICC. http://www.semarnat.gob.mx/informacionambiental/documents/sniarn/pdf/Cuarta_Comunicacion_Nacional.pdf

México. Gobierno del Estado de Veracruz. (2010). Ley Número 878 Estatal de Mitigación y Adaptación ante los efectos del cambio climático. Veracruz.

México. Secretaría de Comunicaciones y Transportes (SCT) (n.d) Número de Líneas de Telefonía Fija y Densidad Telefónica por Entidad Federativa.

México. Comisión Intersecretarial de Cambio Climático. (CICC). (2007). Estrategia Nacional de Cambio Climático. México: CICC.

México. Instituto Nacional de Ecología. (INE) (2005). Cambio Climático: Una visión desde México. México: INE. SEMARNAT .

México. Secretaría de Medio Ambiente y Recursos Naturales. (SEMARNAT) (2006). Manual de Sistemas de Manejo Ambiental. México: Secretaría de Medio Ambiente y Recursos Naturales.

México. Secretaría de Medio Ambiente y Recursos Naturales. (SEMARNAT) (2007). México en el Régimen Internacional de Cambio Climático.

http://www.semarnat.gob.mx/temas/cambioclimatico/Documents/CICC/070713%20Rep.Senado_CC.Mx-vf_02.pdf

México. Secretaría de Medio Ambiente y Recursos Naturales e Instituto Nacional de Ecología (Semarnat-INE). (2006). Inventario Nacional de Gases de Efecto Invernadero 1990-2002. México: Secretaría de Medio Ambiente y Recursos Naturales e Instituto Nacional de Ecología

México. Secretaría de Hacienda y Crédito Público (SHCP). (2007). Decreto por el que se aprueba el Plan Nacional de Desarrollo 2007-2012. Diario Oficial de la Federación, Cuarta sección, 31 de mayo de 2007.

México. Gobierno del Distrito Federal. (2007). Agenda Ambiental de la Ciudad de México. Programa de Medio Ambiente, 2007-2012. Mexico: Secretaría de Medio Ambiente del GDF.

Méndez, E. (2011, February 27). México se inunda de tecnobasura; produce 300 mil toneladas al año. Excelsior. Retrieved March 3 2011. http://www.excelsior.com.mx/index.php?m=nota&id_nota=717925

Ocampo, S. (29 June 2009). Ejecutan a dos jóvenes ecologistas en Ajuchitlán del Progreso, Guerrero. LaJornada. http://www.jornada.unam.mx/2009/06/27/index.php?section=estados&article=028n1est

OECD (2010). Perspectivas OCDE: México. Políticas clave para un desarrollo sostenible. Retrieved December 8 2010. Organization for Economic Cooperation and Development. http://www.oecd.org/dataoecd/22/2/45391108.pdf

Ospina, A. E. Heeks, R. (2010). Unveiling the Links between ICTs & Climate Change in Developing Countries: A Scoping Study . Manchester: Institute for Development Policy and Management, SED

Piedras, E. (2010a, December 6) ¿Necesitamos una agenda digital en México?. Infochannel http://www.infochannel.com.mx/12-23435/necesitamos-una-agenda-digital-en-mexico-'

Piedras, E. (2010b, October 5). Agenda Digital: ¿Qué es y qué no?. El Economista.

Paterson, K. (2010). Temping Down Labor Rights: The Manpowerization of Mexico en CorpWatch. http://www.corpwatch.org/article.php?id=15496

Presidencia.gob.mx (16 February 2009). Programas del Gobierno Federal. Web site Presidencia del Gobierno Federal. México. http://www.presidencia.gob.mx/programas/?contenido=35018

Román M, G. (2008). Taller Retos y Estrategias para la Gestión de los Residuos de Aparatos Eléctricos y Electrónicos en América Latina y el Caribe. REWAS 2008 de Cancún. http://ewasteguide.info/files/2008_Roman_REWAS.pdf

Rodríguez, Y. (21 November 2010). Tecnologías, solución a inseguridad y cambio climático: Slim. W Radio 690.com. http://www.wradio690.com/nota.aspx?id=1388199

SDPNoticias.com (2010). 30 millones de mexicanos conectados a Internet: AMIPCI. Retrieved February 10, 2010. http://sdpnoticias.com/sdp/contenido/estados/2010/05/17/28/1046101

Sepúlveda, P. (2010, April). México, a la baja en TI. Política Digital Innovación Gubernamental en Línea. Política Digital http://www.politicadigital.com.mx/?P=leernoticia&Article=2938&c=7

UNEP, (2009). Sustainable Innovation and Technology Transfer. Industrial Sector Studies. Recycling – from e-waste to resources 2009. http://www.unep.org/PDF/PressReleases/E-Waste_publication_screen_FINALVERSION-sml.pdf

Ugarte, J. (2010, October, 26). Slim eleva inversión para Internet. CNNEspansión.com http://www.cnnexpansion.com/negocios/2010/10/26/slim-apuesta-a-internet-eleva-inversion

Telefónica. SF Ponencia: "Los efectos de la digitalización de la sociedad en el cambio climático". http://www.telefonica.es/acercadetelefonica/fp/aspen/public/ getFile-9.pdf

TyNLatinoamérica (2010, December) Sancionan a Telmex en México. TyNLatinoamérica http://www.tynmagazine.com/Note.aspx?Note=358492