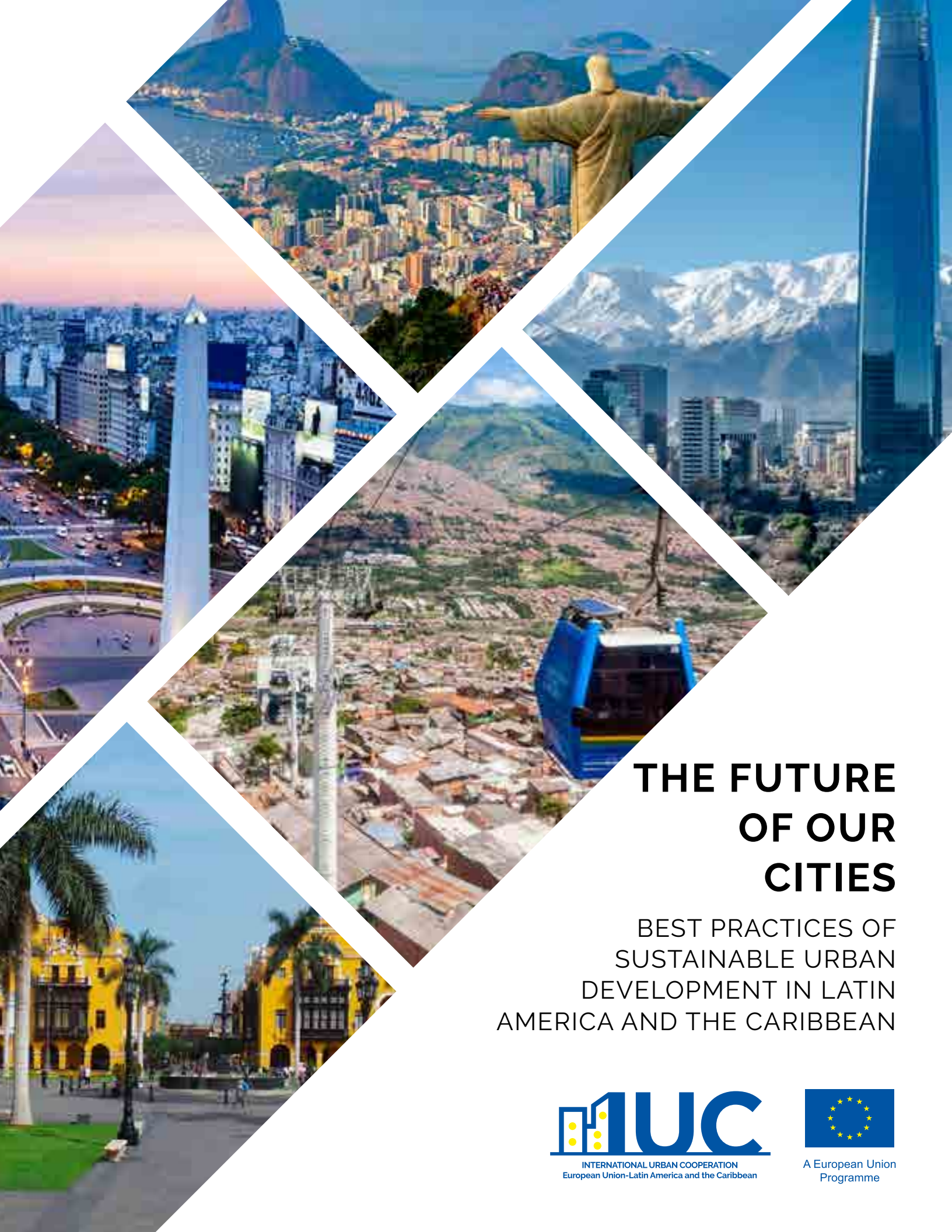

THE FUTURE OF OUR CITIES

BEST PRACTICES OF SUSTAINABLE URBAN DEVELOPMENT IN LATIN AMERICA AND THE CARIBBEAN

INTERNATIONAL URBAN COOPERATION
European Union-Latin America and the Caribbean

A European Union Programme

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FOREWORDS

THE FUTURE OF OUR CITIES

Best Practices of Sustainable Urban Development in Latin America and the Caribbean

Urbanisation is a clear global trend: More than 50% of the global population is urban and it is estimated that by year 2025 this figure will grow to encompass about two thirds of the global population. Whereas urban centres are drivers of innovation and growth, rapid urbanisation brings upon a broad array of challenges ranging from housing, transport and employment to culture and integration. At the same time, cities are directly affected by climate change. E.g. City dwellers are the first to suffer from air and water pollution. Urban environments are also the hardest hit by extreme weather conditions as a result of climate change. However, while cities are part of the challenge, they are also part of the solution. For instance, cities are pioneers in energy transition and adaptation to climate change.

The EU is engaging globally with its support to sustainable urban development, innovation, climate change action cooperation, and smart cities. The EU is committed to continue to work together with the various regions of the globe to build resilient cities, regions and ultimately, societies. The International Urban Cooperation (IUC) Programme is part of a global EU supported action funded by the Partnership Instrument, implemented with the aim of mobilising cities with ambitious sustainable urban development and climate action plans through "platforms" that provide assistance and support the cities in planning and implementing local actions. It follows HABITAT III recommendations and aims at successfully implement the New Urban Agenda (NUA), and this, within other international frameworks, such as the UNFCCC, SE4ALL, etc. It powerfully supports also the implementation of the Agenda 2030 and the Sustainable Development Goals (SDGs), and SDG 11 in particular of making cities and human settlements inclusive, safe, resilient and sustainable.

Cities in Europe are increasingly seeking to address complex issues and challenges, and, through working together and networking; they are developing innovative and original solutions that would not have been possible if left exclusively to the national level. More than ever, cities are key for the EU to deliver on its strategic objectives. Europe's challenges and potentials, such as energy transition, climate change or the integration of migrants and refugees need to be addressed in cities.
Taking into account the urge to act upon these factors, the Urban Agenda for the EU was created and adopted through the Pact of Amsterdam in 2016 by EU Member states. It has been working ever since through an inter-governmental approach, thanks to an innovative governance method designed for cities to have their say in policy-making, but also in the scheme and implementation of better urban policies. With its 14 priority themes that include climate adaptation, digital transition, or urban poverty, it is developing actions plans proposing concrete solutions in order to promote improvements of legislation, funding and knowledge but may also extend to policies, governance and practices. It is also very much aligned with the objectives of the 2030 Agenda and a key implementation mean of the New Urban Agenda in the EU. The positive impact and results of this initiative are already concrete as the National level is opening-up to local authorities' contribution for policy making thanks to the multi-level governance process; Cities are also very much willing to participate and be involved in providing ideas and designing solutions.

This is this experience that we propose also to integrate in our commitment to support urban sustainable trends beyond EU frontiers because we know that partnership and exchanges of lessons learned are powerful tools. Some of the IUC programme's objectives are to promote city-to-city exchanges and working jointly on sustainable urban development through city pairings and to support climate action through the Global Covenant of Mayors for Climate and Energy. The cooperation between cities does not only include exchanges in between authorities, but it also encompasses partnerships and exchanges with business organisations, research and education institutions as well as any other relevant stakeholder that defines the life of any city.

Latin America and the Caribbean is a region of high urbanization with a dominance of cities: nearly 87% of the population live in urban areas. Urban population growth in general is however expected to fall from 1.3% today to 0.3% by 2050, while growth pressure will increase in intermediate cities, hence generating pressure for reforms to boost productivity in cities. Indeed, cities currently contribute to more than 75% of the GDP of the Latin American and Caribbean (LAC) countries. Their role, especially intermediary cities, as the engines of national economic growth and development are also expected to become even more significant. Nevertheless, the challenges facing the economic growth and sustainable urban development in the region have become increasingly difficult and complex —especially as urban centers are growing without adequate infrastructure and services. In many cases, development has come at a high environmental cost, with growing risks from natural disasters, man-made climate change, and widening income gaps between large and small cities in countries across the region. These factors threaten the sustainable growth and development of cities and their economies.
Those challenges inter alia could explain the high number of Latin American and Caribbean cities showing interest in urban cooperation with the EU and EU cities. This has been demonstrated for instance in the 20 pairings realised so far under the IUC-LAC Programme between European cities and cities from Argentina, Brazil, Colombia, Chile, and Peru. These have been exchanging experience and good practices on a variety of themes, such as smart cities, urban mobility, water, waste management and sanitation, inclusive and sustainable economic growth, sustainable use of land and nature-based solutions.
The sharing of case studies on a series of sectors and topics as well as exquisite lessons learned by a sample of cities under the present booklet on sustainable urban development practices allows for the IUC-LAC Programme to share some of the experience gained with cities of the region beyond the first circle of those immediately involved in the implementation of the Programme: a lot of knowledge and experience sharing can help turn global challenges into opportunities for innovation and urban transformation.
That is why we hope this booklet will contribute to a better understanding of innovative urban practices, and to offer inspiration to city managers and urban practitioners.
It has identified successes at local, regional, and national levels and does not intend to offer blueprints applicable to any context, but rather aims at showing, among other issues, how urban practice may change and adapt when decisions are taken in favor of innovation.

Please act as "champions" of the IUC-LAC programme in sharing this booklet with whoever may benefit from its content because The Future of Our Cities is in our hands!

ROSA SABBATELLI

Head of FPI- Regional Team Americas at the Delegation of the European Union to Brazil

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INTRODUCTION

This compilation is an introduction to the documentation of the project for best practices in sustainable urban development for International Urban Cooperation - Latin America and the Caribbean (IUC-LAC). It highlights the best practices selected and presents cases considered to be exemplary for the 11 established sectors. This documentation is inspired by the New Urban Agenda (NUA) and the work that seeks to achieve the Sustainable Development Goals (SDGs) at the urban level.

WHAT ARE THESE SECTORS?

Best practices are proposed to focus on low-carbon urban development and some of the most relevant sectors that contribute to the greatest carbon impacts. The thematic areas selected were: (i) low carbon urban planning; (ii) clean energy systems; (iii) sustainable transport; (iv) ecological construction; (v) urban regeneration; (vi) water - wastewater - flood control; (vii) waste management; (vii) environmental management; (viii) green industries - circular economy; (ix) development of smart cities; and (x) green finance. Urban governance is considered a cross-cutting issue relevant to the previous ten areas.

WHAT ARE THE OBJECTIVES OF THIS DOCUMENTATION WORK?

The objective is to exchange and share knowledge and best practices in the field of sustainable urban development during the implementation of IUC-LAC. The task is part of the proposal for a general description of Best Practices in Sustainable Urban Development in cities in Latin America and the Caribbean that covers five countries (Argentina, Brazil, Chile, Colombia, Peru) that systematize the current state of the art in sustainable urban development and low carbon in participating countries.

WHAT ARE THE BEST PRACTICES?

Best practices are physical or non-physical projects implemented by public or private urban stakeholders.

ONLINE DOCUMENTATION OF BEST PRACTICES:

This compilation is complementary to the online publication of about 165 best practice studies from the five countries on the IUC-LAC website (http: //iuc-la.eu/). Eventually, IUC-LAC and its partners hope to expand this type of documentation work.

INSPIRATION FOR PROFESSIONALS: IUC-LAC

It hopes that these best practices will serve as inspiration for urban professionals in the cities participating in IUC-LAC and other cities interested in participating in the future. The implementation of NAU will depend on thousands of innovative projects!

CHAPTER 1

LOW-CARBON **URBAN PLANNING**

URBAN FORM AND URBAN DENSITIES

Urban densities, land use planning, open space planning, transport planning, and provision of service infrastructure (integrated land use planning) have an impact on how sustainable principles are achieved. City structure and form greatly influence energy consumption, transport modes, and overall quality of life. Urban form also influences residents' access to employment opportunities and livelihood choices based on proximity of other land uses, services, markets, and prevailing environmental conditions. Recent urbanization in Latin America has been largely on city fringes, with cities extending further and further, eating up farmland and converting fertile cropland to new suburbs.[1]

WHY IS COMPACT URBAN DEVELOPMENT IMPORTANT?

Various projections indicate that between 2000 and 2050 the urban space around the world will need to be doubled in developed countries, and be expanded by 326% in developing countries to accommodate people. [2] Cities and their local Governments will have to manage this growth, and counter environmental degradation. "We need compact and well-planned cities"[3] can often be heard. Better urban planning decisions and decisions concerning urban densities will be critical.[4] Spatially, this urban expansion can be accommodated through three spatial strategies: (i) densification in existing areas; (ii) horizontal urban expansion; and (iii) new town development, or a combination of these. Densities of compact urban development that are manageable and suitable will play an important role. Achieving compact and sustainable urban forms is possible where there is strong local government and policies for urban intensification. However, often the process of densification occurs in the absence of policies and control. [5]

Compact city approaches have become one form today of achieving ´sustainable urban development´ or even aiding eco-city development. However, a definition of compact development seems to have been difficult since it remains unclear if the city itself, or the city region should be the point of geographical reference. The question is there whether compaction should be limited to new development in (suburban) subcenters or to existing urban areas.[6] The implications of high density patterns are that economies of scale are reached for trunk infrastructure (i.e. transport, water supply) and in treatment plants (i.e. water purification, waste water treatment). The lower costs per household can be passed on to residents, and smaller debt ensures better fiscal balance. Higher density can enable a city to fund district heating and cooling systems as they service more customers. As higher density developments trigger higher property values, their contribution to public revenues will increase through property taxes. Eventually, higher property taxes, or valuation fees will contribute to pay off the higher costs which are associated with some of the technical implications of densities (for instance need for quality elevators, pumping stations, etc.).

1. Kapoor, P. 2018. Value of Low Carbon Urban Developments. https://www.linkedin.com/pulse/value-low-carbon-urban-developments-prashant-kapoor/
2. Angel, S. et al. 2010. Making room for a planet of cities. Cambridge. Lincoln Institute of Land Policy.
3. Siller, R., "We need compact and well-planned cities". FC – Financial Cooperation Magazine. Special Issue. KfW. Frankfurt. October 2016, pp. 2-3. See also: https://www.equitiesforum.com/blog/2016/11/16/cities-future-compact-connected-co-ordinated/
4. UN-Habitat. 2012. Urban Planning for City Leaders. UN-Habitat. Nairobi http://mirror.unhabitat.org/pmss/listItemDetails.aspx?publicationID=3385&AspxAutoDetectCookieSupport=1
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PRINCIPLES

Nine principles for sustainable urban development are becoming recognised frequently as highly relevant for the cities of the future:

1. **Develop neighbourhoods that promote walking –** by breaking down the block and street sizes, mixing users, and clustering density near transit, the neighbourhood will be more functional, safe, and pleasurable for walking.
2. **Prioritize bicycle networks –** these facilities should be developed while maintaining traffic access.
3. **Create dense networks of streets and paths –** the smaller the block sizes allows for a more intensive and robust system of streets and paths.
4. **Support high-quality transit –** by clustering development near stations and by promoting job/ housing balance, promoting the health and efficiency of the metro system. Street designs include the possibility of transit-only lanes for fast and dependable services.
5. **Zone for mixed-use neighbourhoods –** blocks and place types need to be mixed-use and allow many trips to be made locally at distances which promote walking and bicycle use.
6. **Match density to transit capacity –** recognize the high transit accessibility of public transport systems supporting the significant density of neighborhoods, including housing, employment, retail and civic uses.
7. **Create compact regions with short commutes –** by accommodating growth in appropriate locations, reducing pressure on developable land in more peripheral locations.
8. **Increase mobility by regulating parking and road use –** by reduction or elimination of minimum parking requirements. Parking can be sensibly included without impacting negatively the liveability. [7]
9. **Create Energy Efficient Buildings & Community Systems to Reduce Carbon Emissions –** this points at the relevance of green building and.[8]
10. **Innovation in the field of urban planning in the Latin American and Caribbean Region –** Like in other part of the world, in the LAC region, there is trend towards densification in urban centres – while at the same time cities are extending beyond their original boundaries through dominantly low-rise development. Many of the urban planning initiatives of the transport sector, and of urban renewal may not be presented and seen as a contribution to low-carbon development, although in reality they are. Additionally, in Europe, the Middle East (Abu Dhabi) and East Asia (China, Japan, Korea) there are many recent examples of eco-districts and eco-townships ('Eco-Cities') which amalgamate low-carbon urban planning experiments in a single show-case location, however, the LAC region is yet to see such developments.

7. Adopted from: The Energy Foundation (ed.). 2011. Design Manual for Low Carbon Development. Sustainable Cities Program. http://www.chinastc.org/en/resource/65/479
8. Carl Carlthorpe. 2103. Urbanism In The Age Of Climate Change. http://www.douban.com/note/272680145/

EXAMPLES SHOWCASED

The examples selected to showcase the energy sector innovations are (i) an integrated urban development in Argentina; (ii) low-carbon experimental area in Rio de Janeiro, Brazil; (iii) a city's integrated sustainable development plan in Valdivia, Chile; (iv) a host of urban innovation initiatives in Medell9i8n, Colombia; and (v) the creation of an urban green area that will contribute to the overall greening of Lima, Peru.

COUNTRY	TITLE	LINK
Argentina	Integrated urban development in Salta, Argentina	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Salta_-_Plan_Integral_de_Desarrollo_Urbano_Ambiental_de_Salta_-_Proyecto_Eje_de_la_Integr.pdf
Brasil	Low-carbon experimental area in Rio de Janeiro, Brazil	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Ciudad_del_Rio_de_Janeiro_-_Programa_de_Desarrollo_de_Bajo_Carbono_.pdf
Chile	Integrated sustainable development plan in Valdivia, Chile	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Valdivia_-_Plan_de_Acci%C3%B3n_Valdivia_Ciudad_Sostenible.pdf
Colombia	Urban innovation initiatives in Medellin, Colombia	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Medell%C3%ADn_-_Diferentes_estrategias_de_planificaci%C3%B3n.pdf
Peru	The greening of Lima, Peru	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Lima_-_Creaci%C3%B3n_del_Parque_Forestal_Ecotur%C3%ADstico_Sostenible_%E2%80%9CBoca_de_Sapo%E2%80%9D.pdf

INTEGRATED URBAN DEVELOPMENT IN SALTA, ARGENTINA

In the city of Salta, Argentina the recent Second Integrated Urban Environmental Development Plan (2° Plan Integral de Desarrollo Urbano Ambiental [PIDUA II]) from 2012-2015 has created a approach to integration of otherwise separate and disperse projects. The Integrated Plan has the ambition to increase the value of individual projects, and to prioritize themes which stimulate investments in areas which reduce carbon emissions. With a clear geographical focus on the eastern side of Salta and the north-east of the metropolitan region of the Lerma valley. Transit-oriented development been chosen as a guiding and unifying principle. It unites several layers of transport jurisdictions and includes opportunities for public-private partnerships. This integrated plan seeks a reversal of some of the urban trends of recent decades, less sprawl and horizontal expansion, and a redirection of its growth and development pattern towards a more compact and sustainable city.

Salta and its surroundings | Source: http://municipalidadsalta.gob.ar/

Among the benefits resulting from the transport sector interventions one can distinguish the following features:

• Multi-modal transport forms (public and private transport; bicycle infrastructure; pedestrianized zones) which can accommodate high volumes of movement between the city center and the east of the metropolitan region where a growing transport demand exists and where a growing number of services, employment opportunities, and mayor public infrastructure is located (including an administrative subcenter).

• Modular structure and incremental nature of the staged expansion of the metropolitan transport system.

• Dedicated and exclusive bus lanes for bus rapid transit (BRTs) represent a transport system with high capacity for passenger movement, and lowered energy consumption and reduced CO_2 emissions.

• The BRT stations are likely to become service centers which support the multi-nodality of the urban structure.

Separation of transport modes, allows fluid and secure movement of cyclists and pedestrians who make use of the more compact urban structure and benefit from reduced distances for their commutes.

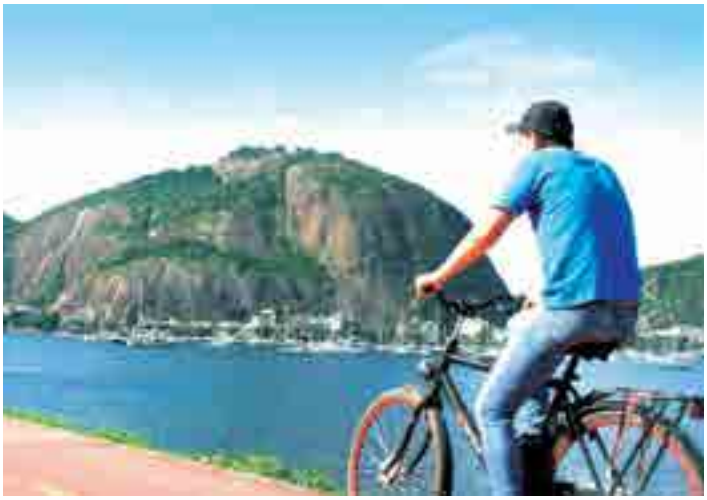
LOW-CARBON EXPERIMENTAL AREA IN RIO DE JANEIRO, BRAZIL

The Low carbon development programme of Rio de Janeiro has established a structure for municipal climate governance that is able to plan, implement, monitor and present accountability of low-carbon investments, and climate change related mitigation measures. The programme was able to integrate various municipal initiatives. It started by identifying the required low-carbon investments, a quantification exercise to reduce green-house-gas (GHG) emissions, and the adequate resulting municipal actions.

Another relevant issue is the programme´s ability to reach out and generate interinstitutional cooperation on issues of GHG emission reductions.

Each new project has to follow a defined process to identify its potential and verify its contributions to GHG emission reductions. The ultimate decisions of coordination and management of the programme rest with Rio de Janeiro´s Office of Climate Change of the Municipal Secretariat of Environmental Conservation. Interventions under the programme can be measures which reduce GHG emissions, like municipal policies relevant for the urban sector, or physical investments in infrastructure (public works, civil defense, transport, urban cleansing), in adaptation to the impacts of climate change, or mitigation of GHG emissions.

Funding for the programme is made available by the Rio de Janeiro Municipality, the World Bank and the Korean Green Growth Trust Fund (KGGTF).



Bicycle route in Rio de Janeiro
source: http://www.rio.rj.gov.br/web/ipp/exibeconteudo?id=4617683

Among the results achieved are not only the municipal efforts of adaptation and mitigation, but also the increased voluntary contributions of urban stakeholders, respecting the municipal policy of climate change and sustainable development.

Challenges for the future will be the regular updating of climate change action plans developed, and its compatibilisation with the international climate targets.

INTEGRATED SUSTAINABLE DEVELOPMENT PLAN IN VALDIVIA, CHILE

The city of Validiva has expanded horizontally with low density (56,5 inhabitants/hectare). This has resulted in occupation of high risk and vulnerable areas (like swamps). The urban sprawl has lead to higher use of private cars, as distances grew, and the quality of public transport made its use unattractive. Despite urban sprawl there was even a reduction in public transport, and instead of walking people use their cars more. In this context emerged the Valdivia Action Plan for a sustainable city as part of the Inter-American Bank (IDB)-sponsored Initiative for Emerging and Sustainable Cities Initiative (ESCI). In Valdivia, the Subsecretariat for Regional Development coordinated the contributions of various public (and private) institutions.

The development of the action plan was an inter-institutional work, integrating baseline studies integrating (i) analysis of GHG emissions, (ii) identification and analysis of disasters and vulnerability of negative impacts of climate change, and (iii) evaluation of proposed investment projects and their possible impacts on land use and the environment. The multi-sectoral diagnosis utilized the IDB-ESCI methodology to identify critical hotspots of the city, and suitability of proposals to make Valdivia a sustainable city.

Valdivia wáter front. | Source: https://webimages.iadb.org/PDF/PLAN+DE+VALDIVIA+27-05.pdf

The Action Plan proposal envisaging $1 bn investments is immensely ambitious. Hence, only a select few of the actions can be realized with the resources available to the city, like the construction of bicycle routes; the replacement of heating systems using low-carbon technologies (using other, non-municipal sources); and the developed a of river taxi system (using private sector investments). The important lesson of the plan is that gives incentives to a permanent search for funding and investment opportunities. Thus, concerning its financing, the plan is assuming a long-term perspective, and regular updates of the city´s master plan (Plan Regulador Comunal) whose target – among others – is institutional strengthening of the Municipal Secretariat for Planning (SECPLAN), and the sustainability of fiscal initiatives. Resource mobilization is the principal challenge for the plan. Initiatives for further resource mobilization will become connected and related to the regional investment initiatives of the regional government and public service companies. Relevant for the long-term evolution of the plan is its transcendence to a respected agenda, independent from political developments and changes in municipal governments, based on the consensus among many urban stakeholders it represents. Thus, the challenge exists to keep the plan alive and project its implementation to future municipal governments.

URBAN INNOVATION INITIATIVES IN MEDELLIN, COLOMBIA

Medellin has positioned itself in recent years among the most innovative and smart cities which strived to achieve environmental, economic and social sustainability. It has become the image of a city re-invented – in Latin America and the world over. Medellin´s strategies for low-carbon planning are focused on the following lines of action:

- Re-greening of densely inhabited zones, with high temperatures (heat islands), specially in the historic city center, along traffic routes with high frequencies. In some part of Medellin massive tree planting campaigns are planned.
- Development of a metropolitan green belt which limits and demarcates the buildable territory, and guarantees environmental protection of mountain slopes. This will allow a clear distinction between urban and rural areas.
- Recovery of water resources through the Plan for mountain slopes in the Metropolitan Area of Aburrá and its 10 municipalities. The actions are focused on the conservation of 19 water sources of the Medellin River, from its origin, through sanitation measures, education, and environmental sensibilization of the adjoining and relevant communities.
- Mitigation of atmospheric contamination through restriction or circulation of vehicles (´pico y placa´), and industrial pollution control.
- Expansion of public mass transport offering different transit modes for different sectors of the city (rapid bus transit; tram lines; and cable systems into mountains regions and disadvantaged neighbourhoods – like Comuna 13 - of the city), powered by electric energy which originates from renewable, non-polluting sources. This multi-modal transport is managed by the Metro of Medellin company.
- Generation of alternative non-motorised mobility patterns: pedestrian zones, cycleroutes complemented by a public bike sharing system (´EnCicla´) which links to the metro transport system, the administrative city center, and connects the institions of higher learning.

Comuna 13
Source: https://noticias.caracoltv.com/medellin/el-graffitour-es-uno-de-los-atractivos-turisticos-preferidos-por-la-gente-que-visita-medellin

Estación EnCicla en la Alpujarra.
Source:http://www.terminalesmedellin.com/convenio/sistema-de-bicicletas-publicas-sbp-encicla/

Medellin´s environmental innovations, though still on s small scale, may become city-wide initiatives and mainstream these projects, due to political support for these and the success of citizen´s environmental education. To fight the massive threat of Medellin´s heavy air pollution, more serious measures like massive introduction of electromobility, and pollution control of industries will be required.

THE GREENING OF LIMA, PERU

The district municipality of Independencia (´Índependence´) in the metropolitan region of Lima has implemented a project for Disaster Risk Reduction in vulnerable areas of Indepencia, which was implemented by the NGO Centro de Estudios y Prevención de Desastres (PREDES) and the local residents groups (Juntas Directivas de los asentamientos humanos [AA.HH.]) of the informal settlements of El Volante II y El Volante III which are located on the mountain slopes of Independencia. Other actors of this multi-institutional and participatory effort were soldiers of the local army base (Cuartel Hoyos Rubio del Rímac [Ejército Peruano]), members of the catholic church and of the Mormon sect, plus some staff of municipalities of the northern region of Lima.

The project has achieved the reforestation and planting of some 3381 trees in the newly created eco-touristic Park "Boca de Sapo". The park includes a modern drip-irrigation system for the maintenance of the plants. Since the creation of these green areas on the mountain slopes, the disaster risk for the population has decreased. There are no more earth slides, and rains do not cause deranges of stones and rocks.

At the same time, the zone has been protected from further invasions and additional informal settlements, and informal sale of urbanisable land. Through legalization measures of this settlement, a total of 171.5 ha has been registered as government property and is protected under as the Parque Ecoturístico Forestal "Boca de Sapo".

Location of the Boca de Sapo.
Source: Perú Sin Riesgo de Desastres
https://www.perusinriesgodedesastres.com/noticias-2016/noviembre/%C3%A1rboles-para-reducir-riesgo-de-desastres-y-frenar-expansi%C3%B3n-urbana-informal/

Disaster management and the control of informal settlements in the outlying marginal districts of metropolitan Lima represent an environmental and urbanistic innovation. The greening of these formerly desertic regions will contribute to an increased capacity of co2 absorption, and thus reduce the overall impact of GHG emissions of Lima.

CHAPTER 2

CLEAN ENERGY

Since the 2015 Paris Agreement on Climate Change cities are striving to do their part in achieving low-carbon development and de-carbonisation through a number of priority approaches, including the promotion of clean energy. The decarbonisation concept will be achieved through new energy technologies that provide clean energy in a dec4entralised fashion. Supported by large industries, the low-carbon approach is gaining rapid support world-wide and renewable energies prove to become more cost-efficient than the conventional carbon-based development approach. For cities it will be important to make informed choices for decentralised new energy systems.[9] Much of the eventual success of the new energy systems to be introduced will depend on the use of micro-grids which will supplement the existing systems of energy providers. Since cities are engaging in a range of energy innovations which will help them to transform their energy production and consumption with considerable impacts for climate change, it appears necessary to consider joining the global campaign of cities, supported by the European Union. The key instrument of these cities engaged in the global campaign is the formulation of detailed plans (Sustainable energy and climate action plans [SECAPs]).

Energy is a cross-cutting issue that affects transportation, buildings, water supply, waste water treatment, solid waste management and other urban infrastructure. Developing an energy profile of a city enables the level of use, mix of energy types, and patterns of use by sector or end use activity to be considered. International pressures, national legislation and growing public awareness are causing us to change our approach to fueling our cities, and to hunt for solutions that are truly sustainable. While many cities traditionally have limited administrative power over energy, their carbon targets, vulnerability to climate risks and opportunities around green growth are spurring them to take a greater leadership role. Some model cities have enacted bold policies, supported by creative financing and investments to support a low carbon path. The future lies in alternative, clean energy sources which are effectively limitless and sustainable, and mostly free of geopolitical considerations.[10] Renewable ¨new¨ energy is seeing unprecedented levels of growth, spurred on by dropping technology costs and strong policy support. A prominent feature of ¨new¨ energy often times is its decentralised nature, and the resulting need for the creation of micro-grids for distribution. Many cities have been adopting innovative energy programs, some for experimentation, others for massive application. World-wide the EU-backed Global Covenant of Mayors (GCoM) has triggered the formulation of city-level sustainable energy action plans (SEAPs) which promote the use of renewable clean energy in cities.

BEST PRACTICES

Numerous best practice experiences in the region illustrate the ongoing changes in the energy sector. The publication of Nationally Determined Contributions (NDC) not only announces the national targets for enhanced action on climate change for 2030 but also spells out policies and measures to implement them. Among these, the urban arena is explicitly mentioned several times as area for actions, most prominently in regard to regional policies and control of emissions from buildings and transportation. The future sector agenda can be grouped by the following headers: (i) renewable energy policy; (ii) power supply system and market design; and (iii) technology focused policies.

9. https://www.esmartcity.es/2016/11/10/hacia-una-transicion-energetica-renovable-en-las-ciudades
10. Eficiencia energética y energias renovables. https://www.giz-cepal.cl/files/ee_er.pdf

RENEWABLE ENERGY POLICY:

- Create a comprehensive national energy plan covering infrastructure needs for transmission and distribution of electricity, heat and gas;
- Develop taxation instruments, emission limits, and/or CO2 trading systems to counter the damage of CO2 emissions and air pollution from use of coal;
- Evaluate the impact of various new energy technologies on socio-economic development, energy security, health, land and water use;
- Establish renewable energy targets in industries, buildings and transport.

POWER SUPPLY SYSTEM AND MARKET DESIGN:

- Create the national power market, providing economic incentives for operations in renewable energy, and bringing in new investors in new energy;
- Reform the grid to better integrate renewable energy, enhance trade of renewables and deal with variability and fluctuations in supply.

TECHNOLOGY FOCUSED POLICIES:

- Stimulate (national) government support for innovation, research and development to reduce renewable energy costs;
- Foster next-generation renewable energy technologies;
- Enhance knowledge and data collection on biomass and the feedstock market.

The energy use has grown rapidly in recent years, and by 2030 it will increase due to a surge in population and economic activities. In a business as usual scenario, the country will not only be the world's largest energy consumer by far, but also emit over twice the quantity of CO2 of the next largest emitter. Without increased deployment of renewable energy, the region's energy system will continue to result in high levels of air pollution, negatively affecting health, economic growth and the environment. Without the diversification of its energy system and a transition towards renewable energy, the country will become increasingly reliant on imported fossil fuels, affecting its national energy security and economic growth. If the region acts decisively to increase the role of renewables in its energy system, it can significantly reduce the pollution of its environment, enhance its energy security, benefit its economy and play a leading role in mitigating climate change.

INNOVATION IN THE ENERGY SECTOR IN THE LATIN AMERICAN AND CARIBBEAN REGION.

Like in other part of the world, in the LAC region, solar energy is on an upsurge, and many countries are considering already their carbon exit strategy. In many LAC countries, renewables (solar, wind, and bio-energy) have a high growth potential, and for instance Chile's new power plants are using renewables. The renewable energy sector will receive an additional push in the coming decade with the massification of electric vehicles in the region. On the other hand, large producers predict that the shift to energy efficiency should result in long-term savings of some 30% in cities. The energy innovators, like Shell, propagate the slogans like 'Lets power our future with energy we couldn't use before', 'Let's light up our cities with a cleaner source of electricity', and 'Let's heat our cities with cleaner energy' which illustrate the onset of an energy revolution.

EXAMPLES SHOWCASED

The examples selected to showcase the energy sector innovations are (i) a solar-powered public water heater and charging station for cars and electro bikes in Codoy Cruz, Argentina, (ii) a sustainable neighbourhood lighting system in Bananeiras, Brazil; (iii) a district heating system based on clean energy in Chile, (iv) solar energy use in a modernized industrial plant in Colombia, and (v) wind energy production in Peru.

COUNTRY	TITLE	LINK
Argentina	Solar-powered public water heater and charging station for cars and electro bikes in Codoy Cruz, Argentina	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Godoy_Cruz_-_Solm%C3%A1foro_Torre_para_calentar_agua_y_tel%C3%A9fonos_celulares__Auto_y_bicis_el%C3%A9ctricas.pdf
Brasil	Sustainable neighbourhood lighting system in Bananeiras, Brazil	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Bananeiras_-_Iluminada_y_Sostenible.pdf
Chile	District heating system based on clean energy in Chile	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Cobertura_Nacional_-_Calefacci%C3%B3n_Distrital.pdf
Colombia	Solar energy use in a modernized industrial plant in Colombia	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Santiago_de_Cali_-_Postob%C3%B3n-CELS%C3%8DA_en_Yumbo__Valle_del_Cauca.pdf
Peru	Wind energy production in Peru	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Talara_-_Central_E%C3%B3lica.pdf

SOLAR-POWERED PUBLIC WATER HEATER AND CHARGING STATION FOR CARS AND ELECTRO BIKES IN CODOY CRUZ, ARGENTINA

There are certainly many (mostly small-scale) initiatives of renewable energy projects in Argentina. However, this experience of the city of Codoy Cruz stands out as pilot project which combines various policy and technology initiatives.[11] Codoy Cruz has developed a solar energy tower ("solmaforo" or solar traffic light), powered by photovoltaic cells, which provides energy for the charging of electric cars and bikes, located in a public area (´solar´ square) of Codoy Cruz. The "solmaforo" performs an important role for users, and at the same time is a vehicle for citizens´ education. The "solmaforo" offers the following services: (i) facilities for charging of cellphones and tablets, (ii) charging facility for electric cars and bikes which the city has purchased for its environmental police, (iii) dispenser of hot water for citizens who drink ´mate´ (a much beloved Argentinian variety of tea), and want to refill the thermo-bottles. The "solmaforos" also contain devices which measure and display information about solar radiation, and emergency call systems (911).

Since 2017, Codoy Cruz has installed some 9 of these "solmaforos" in public spaces and public green areas. Additionally, it has created other more innovative forms of public solar energy sources, the so-called solar trees.

Semáforos | Source: Secretaría de Ambiente

Árboles Solares | Source: Energía de la Municipalidad de Godoy Cruz

With these technologies, Codoy Cruz has launched important innovations which are expected to go a long way with the future introduction of electromobility, and they provide welcome community services in public outdoor areas.

11. Concejo Municipal de Godoy Cruz, Ordenanza N° 6664/17 "Programa Municipal de Promoción y Fomento de Energías Limpias". Recuperado de: https://www.godoycruz.gob.ar/sitio2/wp-content/uploads/2017/06/Programa-Municipal-de-Promocion-y-Fomento-de-Energ--as-Limpias.pdf

SUSTAINABLE NEIGHBOURHOOD LIGHTING SYSTEM IN BANANEIRAS, BRAZIL

Public lighting in Brazil´s municipalities is obsolete and precarious, and at a high cost for its citizens. The sustainability of public lighting is in question, since there is no designated system to generate revenues for street lighting.

The sustainable street lighting project of Bananeiras, a municipality in the state of Paraíba in the Northeast Region of Brazil, emerged from the necessity to reduce energy consumption of cities for street lighting. The project wanted to turn the lack of energy efficient street lighting into an opportunity for private sector technology innovators. The project is intended to give good visibility to its results, with the bigger aim to attract other private investments in environmentally correct projects.

Main church of Bananeiras

City of Bananeiras

Source: Ascom Prefeitura Municipal de Bananeiras

For the implementation of this project, the municipality established a partnership with its energy company Energisa. Based on opportunities offered by Law 9.991/2000 it is permitted to invest annually 05% of its revenues in energy-efficiency measures. With these resources available, the energy company has started to replace conventional light bulbs with LED. The impact on spending for public lighting has been immediate, and today the attractions of the city center can be admired by citizens and visitors. 94% of the central areas has LEDs. An indirect benefit is experiences by local businesses and restaurants.

The lessons from this project confirm the value of public-private partnerships, and impacts even small investments can have when well administered and well-targeted.

DISTRICT HEATING SYSTEM BASED ON CLEAN ENERGY IN CHILE

Atmospheric contamination is a serious and critical health threat in many cities of Chile (Coyhaique, Padre las Casas, Osorno, Temuco, Andacollo y Rancagua), due to the continued use of carbon-based fuels by the transport sector, heating of buildings (mostly done with fire wood). Some premature 4000 deaths at national level are accounted for due to exposure to high concentrations of MP2,5.

To combat air pollution, many cities in Chile have drafted Plans for Atmospheric Decontamination, and started to address the heating systems in place. The concept of a more energy-efficient district heating (Calefacción Distrital [CD]) has started to get traction in Chile. The decontamination plans mention district heating and warm water supply as a means to reduce energy consumption and contribute to cleaner air in cities.

In a 2016 study a national route map for district heating was established. Several pilot cases [12] were proposed for retrofitting of heating systems, making use wood chips instead of carbon-based fuels. The most prominent case are the towers of San Borja which received highly efficient heaters (for 3MWth) for its 2.600 apartments.

Condominio Cumbres del Cóndor, Santiago
Fuente: http://www.pabellon.cl/noticias/index/detalle/id/154/inmobiliaria-manquehue-innova-con-calefaccion-distrital-por-biomasa-en-departamentos-cumbres-del-condor.html

While progress on this kind of initiatives may still be small, Chile´s cities advance this energy-efficiency agenda step-by-step, and cities like Temuco and Coyhaique have shown important commitment to this agenda. The policy objective of the route map is to achieve that by 2025 district heating has become a viable and acceptable technology for Chile´s cities. The target is to triple the number of district heating capacity by 2025.

The current challenges lie in the lack of normative instruments to advance this agenda, and a lack of understanding of business models for this form of energy-efficiency. More needs to be done to increase knowledge on thermic comfort, air quality under indoor conditions, and the economics of district heating.

Ilustración de la calefacción distrital

Source: http://www.energia.gob.cl/tema-de-interes/expertos-analizan-potencial-de-la

12. Torres de San Borja (1969) y el condominio Cumbres del Cóndor (2015) en Santiago, el condominio Hacienda en Piedra Roja, Chicureo en Colina (2015) y los proyectos de la Villa San Sebastián (2016) y el condominio Frankfurt (2008) en Temuco

SOLAR ENERGY USE IN A MODERNIZED INDUSTRIAL PLANT IN COLOMBIA

In Colombia the demand for electric energy is steadily increasing, due to population growth and expansion of industrial activities. In order to manage and control its energy expenses, Celsia Solar Yumbo, a company of the Argos conglomerate, has invested in its own photovoltaic solar energy system, and supplying Postobon, a softdrink company in Yumbo near Cali.

The photovoltaics plant (´granja solar´) in Yumbo sells 40% of its total production to Postbon, or an equivalent of 6 MW of its 9,8 MW installed capacity. The remaining electricity is sold to the national grid. These 6 MW of clean energy help to avoid 100.000 tons of carbon emissions (COR2R) over 25 years – or 16 million trees or the creation of 14.700 hectares of new forest to compensate for the emissions.

Celsia Solar Yumbo

Celisia Photovoltaic panels

Fuente:http://www.mundoelectrico.com/wp-content/uploads/2017/02/celsia.jpg; http://www.celsia.com/Portals/0/EasyDNNnews/2262/Celsia_250.jpg

Celsia is the first commercial provider of solar energy, and the plant in Yumbo, Cali is its first large-scale facility. Celsia offers similar plants to other companies which are interested in cheap and reliable electricity supply.

The Celsia case offers an important milestone in Colombia´s efforts to introduce clean energy through private sector investments. It helps to reduce dependency on fuel-based energy, and as the project demonstrates well, it can start with smaller plants. Financially speaking, the system is sustainable and good business.

WIND ENERGY PRODUCTION IN PERU

Peru´s Ministry of Energy and Mines (MEM) has estimated that wind energy capacity to be approximately 22,450 megawats (MW), of which currently only 239 Mw are utilized for the generation of electric energy. Since 2014, peru has several big wind farms: ´Marcona´ in Ica (32 MW), ´Cupisnique´ in La Libertad (80 MW), and ´Talara¨(Piura) with 30 MW. These projects have been under development since 2011 through a concession with the wind energy firm Energía Eolica which developed the projects in Talara, while the firm Contour >Global has developed the other projects.

Both operators use 80m high aerogenerators which are mounted at a distance of 150 m from each other to avoid, or 300 m when installed in parallel rows, to avoid turbulences. The energy generated is being fed into national grid, and sold to the national energy company. Such practice is possible under special service contracts, but is not et established for individual households or companies producing their own solar energy.

Wind energy in Peru
Source: https://www.osinergmin.gob.pe/seccion/centro_documental/electricidad/Documentos/PROYECTOS%20GFE/Acorde%C3%B3n/Generaci%C3%B3n/1.7.3.pdf

The existing wind energy projects are certainly important pilot projects. But currently (in 2019) Peru does not yet count on a Peruvian legislation which would recognize the importance of wind energy as an energy resource. Due to this lack of legislative framework, wind energy can still not compete with conventional fossil energy sources. This situation persists despite the international interest in Peru´s potential of renewable energy.

CHAPTER 3

SUSTAINABLE **TRANSPORT AND MOBILITY**

GREEN TRANSPORT

Green transport is expected to help reduce air pollution in Cities and to change the way people move around. The approach to decarbonisation of cities is complemented by the many ´new energy´ vehicles and modes of transport which have come onto the market. The sustainable transport paradigms are best illustrated by the ´avoid – shift – improve formula which calls for an integrated approach to city-wide transport planning. To decide for certain ´new energy´ vehicles and transport strategies, it is crucial to be able to assess their contribution to reduction in emissions, upfront before investing in these technologies. Complementary to the emission assessment, is the need to decide for the most adequate and cost-efficient environment friendly transport technologies. Motorised transport technologies are as important as (the need for) non-motorised transport (walking and cycling) which will make cities more lovable and healthy places. [13]

SECTOR PROFILE

Despite references to sustainable transport in the UN 2030 Agenda for Sustainable Development and the New Urban Agenda there is no globally agreed definition of sustainable or green transport. In urban areas, transport covers the movement of people and freight (e.g. goods, waste and service trips) to, from and within urban areas. Green refers to the environmental pillar of sustainability which may be direct local (e.g. noise or air quality) or national or global impacts (e.g. climate change). Green Transport is the efficient, clean, safe and affordable movement of people and goods in urban areas. It is generally accepted that this can be done through widespread use of shared mobility (e.g. public transport, car sharing) supported by walking and cycling. In Europe although the broader term "sustainable transport" (including all three of the economic, social and environmental dimensions of sustainable transport) is widely used most attention is given to the environmental dimension – with generally less attention given to the economic (e.g. ticket prices, public subsidies) and social dimensions (e.g. access for people with disabilities, personal security) with the general exception of road safety.[14]

Conventionally, transport has been seen as a pre-condition for economic development. This has caused vehicles to take the centre stage, and most cities to become ¨car cities¨. The aim was to make the use of vehicles as convenient as possible. Reducing the costs of using the private vehicle and the use of trucks for the transport of goods has long been considered a desirable development goal. Heavy investment in road infrastructure, low-density urban development and fuel subsidies are exemplary heritages of years of vehicle-centred policy making. Traditional planning of transportation infrastructure needs in cities was done mainly on a "predict and provide" basis. Planners predicted the growth in demand for the use of private vehicles and built the infrastructure to accommodate this growth. This put the movement of the vehicle in the centre instead of the movement of people or goods. Increasing congestion, environmental problems, reduction in the quality of public transport and increasing costs of sustaining the transport system have led to a discussion on the compatibility of liveable urban space and cars in Europe and elsewhere. A discussion that is more and more emerging in LAC cities as well. The emergency of new paradigms in transport has made it imperative to implement the Avoid–Shift–Improve approach in transport. As cities adopt new transport policies and low-carbon technologies, it will become necessary to develop integrated low-carbon transport plans. As a tool for decision making, the assessment of co2 emissions will add a parameter in deciding in favour of low-carbon transport technologies. As part of integrated city-wide low-carbon transport plans, there will also be elements of non-motorized transport (walking and cycling).

13. CAF.2011. Desarrollo Urbano y movilidad en America Latina. https://www.caf.com/media/4203/desarrollourbano_y_movilidad_americalatina.pdf
14. Major, M. 2017. Green Transport – Issues Paper. EC-Link Project. Beijing (unpublished).

POLICY DIRECTIVES

Several LAC countries have developed transport sector roadmaps which include extension of public transport, adoption of the transit-oriented development concept, and promotion of non-motorized transit:

- **Complete urban public service.** The development of public transport enjoys priority in many countries of the region. However, due to the weak public fiscal system, there is a coinsiderable backlog in urban public transport which has given huge incentives to indivudal car ownership.
- **Transit-oriented Development:** Cities should be built around their public transit systems. The area within 500-800 meters of major transit stations, such as the metro or bus rapid transit (BRT), or within 500 meters of nearest bus or transit stops (in case BRT or Metro is not available) should have FAR at least 50% higher than the average of the district. For big cities, at least 70% of residents should live in TOD areas characterized by convenient mass transit service.
- **Non-motorized Transit:** There should be dedicated and connected walking paths and connected biking paths.
- **Car control:** Every city should have a strategy to cap car use. Where high-quality transit exists, there should be limits on parking.

INNOVATION IN THE TRANSPORT AND MOBILITY SECTOR IN THE LATIN AMERICAN AND CARIBBEAN REGION

Like in other part of the world, many cities in the LAC region are modernizing their public transport fleet. New bus systems are being introduced, and the race is on for cleaner technologies (e-buses, methane gas, hybrids, or Diesel Euro VI). Larger cities are setting their eyes on underground or above-ground metro system, though national government financing is invariably a precondition given limited financial capacity of most cities. The use of private vehicles (cars and motorbikes) has surged in all cities given the increase in living standards, and so have pollution and fatal transit accidents. Mitigation of the pollution is being promised by the introduction of cleaner and more sustainable technologies (electric cars, electric motor bikes) as well as by wider promotion of non-motorized transit, use of bicycles and walking. Several cities across the region have opted to introduce electric bus systems [15] - Santiago de Chile, Cali and Medellin, and Guayaquil, while Sao Paolo, Buenos Aires, San Jose and Montevideo are working on similar schemes. However, the massive use of cleaner electric cars seems still far away, due to cost and lack of supporting infrastructure. Bicycle sharing systems have helped to popularize the use of bikes for short distance trips, and new internet applications are at hand to support their use. Besides the imminent innovation in the private transport sector, many cities have introduced more inclusive private transit system to their informal city areas: a host of cities are using cable cars and electric tram systems, both at relatively low cost, to connect poor neighbourhoods with city centres, and thus provide an important step to social integration for poor citizens. The urban planning systems slowly are starting to accommodate these transport innovations through integrated multi-modal transport and mobility plans as part of the urban development scenario. The broader perspective is to reduce private motorised transit, and to put pedestrians and non-motorised transit on a more equal footing.

15. of the Chinese-British BYD brand: See: https://www.chinadialogue.net/article/show/single/en/11090-Chinese-electric-buses-make-headway-in-Latin-America?mc_cid=2f500e5b74&mc_eid=8282aefccf

EXAMPLES SHOWCASED

The examples selected to showcase the transport and mobility sector innovations are (i) the integrated transport and mobility plan for Rosario in Argentina; (ii) the plan for the use of alternative energy vehicles in Fortaleza, Brazil; (iii) low-carbon transport systems in Santiago de Chile; (iv) Bogota's rapid and massive bus transit system – el Transmilenio; (v) and the sustainable mobility plan for San Isidro, Lima in Peru.

COUNTRY	TITLE	LINK
Argentina	Integrated transport and mobility plan for Rosario, Argentina	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Rosario_-_Plan_Integral_de_Movilidad_de_Rosario.pdf
Brasil	Alternative energy vehicles in Fortaleza, Brazil	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Fortaleza_-_Proyecto_Veh%C3%ADculos_Alternativos_para_Movilidad__VAMO_.pdf
Chile	Low-carbon transport systems in Santiago de Chile	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Comuna_de_Santiago_-_NAMA_Zona_Verde_para_el_Transporte_en_Santiago__ZVTS_.pdf
Colombia	Bogota's rapid and massive bus transit system – the Transmilenio	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Bogot%C3%A1_-_Transmilenio.pdf
Peru	Sustainable mobility plan for San Isidro-Lima, Peru	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Lima_-_Plan_de_Movilidad_Sostenible_en_Lima.pdf

INTEGRATED TRANSPORT AND MOBILITY PLAN FOR ROSARIO, ARGENTINA

The Integrated Mobility Plan has been in development since 2010. It promotes integrated transport and mobility solutions, and seeks sustainability. The Integrated Mobility Plan complementes the strategic development of metropolitan Rosario (PERM), and the urban development plan (PUR). Currently, many of the plan´s are already under implementation, with its three strategic areas: (i) promotion of public mass transport, (ii) development of non-motorized transport, and (iii) dissuasion of private motorized transport. The following measures are key features of the Mobility Plan:

- The creation of obstruction free exclusive lanes for public transport, particularly in the downtown central business district. This is where the MetroBus assumes an important role. The separation of transit modes allows private cars to use the remaining two lanes. This component was funded under a World Bank project for metropolitan transport.
- The new electric bus line known as "Q" is a trolley bus system which connects southeast and east of the city with the city cenhtre and the university campus (Ciudad Universitaria). These trolleybuses last longer than conventional diesel buses, and are cleaner. These buses are operated with batteries and allow travel radius of 20 Km.
- Clean energy vehicles (Euro V technology).
- Public bicycle scheme "Mi Bike is your Bike" ("Mi bici Tu Bici") with 52 docking stations. Currently operating with 450 bikes, and 70 tandem bikes.
- 130 km of exclusive bike lanes, and 1.700 bike parking spots.
- Disincentives for private car use through parking restrictions.

Rosario is seeking a new role for its transport and urban mobility sector: to be an integrator, sustainable and respectful of the human scale. The city´s Integrated Mobility Plan established the sector as the prime spine for urban development planning and the strengthening of new strategies which the call for citizens´ participation. Rosario intends a paradigm change towards a new more complexity which will help to recover the lost human scale which has disappeared under a pure infrastructural notion. The implementation of the various transport operations is supported by a central traffic management system (Centro Integrado de Operaciones Rosario - CIOR).

Dedicated esclusive bus lane.
Source: http://www.etr.gov.ar/carriles.php

ALTERNATIVE ENERGY VEHICLES IN FORTALEZA, BRAZIL

The city of Fortaleza has embarked on a scheme of alternative energy vehicles which are available for rent under the Project for Alternative Vehicles for Urban Mobility (Mobilidade [VAMO]), promoted by the Secretariat for Conservation and Public Services (Secretaria Municipal de Conservação e Serviços Públicos [SCSP]). 100% of all vehicles utilized are electric, and they are available at specific points in the city. It is assumed that one rental car can replace 6 private cars when its use is combined with public modes of transport.

Electric vehicles used by VAMO

Electric vehicles ready to use

Source: http://www.vamofortaleza.com/#welcome, Prefeitura de Fortaleza

The VAMO system stimulates the concept of car sharing. It offers the advantage of availability on demand, and its maintenance is done by a private transport agency (Serrtel). Each station has four fast chargers. When vehicles are not in use they are being connected for recharge.

VAMO charges a user fee according to the duration of use. Renting and payments are managed through a smart phone application (app). For frequent users there are attractive long term subscription fees. Prior to the first renting, a test drive needs to be passed as part of the registration process.

Within the first two years of its operations some 3.823 clients have registered. It is assumed that the system offers attractions for short rides below one hour. In terms of emission savings it is estimated that during the first two years of operations, 500 tonnes of co2 have been saved due to its clean technology.

For the operator this has been an important test phase concerning the supervision of this car fleet, and its supervision by global position systems (GPS) and onboard computer systems. The maintenance of docking stations has been the most critical for the municipality of Fortaleza, and its day-to-day interaction with the private operator and sponsor.

Though the experience is still small-scale with some 20 vehicles in 2019, its innovative nature is presenting this as a highly innovative scheme which is likely to have many cities copying the scheme.

LOW-CARBON TRANSPORT SYSTEMS IN SANTIAGO DE CHILE

Chile is considered a country with a high potential for electromobility, due to the existence of lithium (52% of the world resource available in the north of the country) which is necessary for the production of lithium batteries.

Currently thee are about 300 electric cars in Chile which certainly is still a very small umber. The expected transformation is that of the whole energy system. The sources of electricity matter. For instance, 60% of Santiago´s metro system is fed by renewable sources, and the challenge will be to achieve 100% renewable sources.

Since 2017, the country has a Strategy for Electromobility which is the result of intensive work between the public and the private sector. >The strategy contemplates the creation of regulation and standards, the lead role of the public transport, the training of human resources and performance monitoring, incentives for switching to electromobility, and information about advantages of electromobility.

Recently, Santiago saw the tender of a fleet of some 80 electro buses. Other cities like Valparaiso, Viña del Mar and Concepcion have also shown interest in electromobility and there is a general boost in confidence in this technology. In the Santiago region, the Italian firm Enel is providing the majority of infrastructure and technology support.

The medium-term strategy envisages that by 2050 105 of all public transport vehicles will be electric, and that the share of private vehicles will be at 40% (5 million vehicles). While this may look like a conservative estimate, much will depend on the evolution of smart city infrastructure, and the cost of electromobility. Cheaper electric cars and buses, faster charging, and a wider network of public charging stations will accelerate this process and possible allow an earlier date for achievement of these targets. The technology change is expected to improve air quality and increase quality of life.

Transantiago at a charging station
Source: www.codexverde.cl

Each electric vehicle will stop emitting 3 tons of carbon dioxide, or the equivalent of 1.300 liters of fuel, and electric vehicles will prove to be 80% more economic than conventional fuel-based vehicles. In the public transport, the cost reductions are estimated to reach 70%.

The challenge will be to manage the transition process, and to create the necessary institutional and technical infrastructure.

BOGOTA'S RAPID AND MASSIVE BUS TRANSIT SYSTEM – THE TRANSMILENIO

Bogota´s population has a strong relationship with its Transmilenio bus system. Some 37% of the persons use it regularly, although public transport represents only 5% of all vehicles. Prior to the arrival of the Transmilenio in year 2000, some 30.000 desolate micro-buses transported 72% of the population at an average speed of 13km/h. Private vehicles transported some 19% of the urban population. Marginal districts remained without transport, and walking was a prominent form of mobility. Transmilenio has been inspired by s similar, but smaller system in Curitiba, Brazil. The integrated system of the Transmilenio consists of the main bus rapid transit (BRT) on designated lanes, and feeder buses (SITP).

SITPO feeder buses

Transmilenio Buses - fast and slow lanes

Fuente:http://www.sitp.gov.co/loader.php?lServicio=Galeria&lFuncion=verAlbum&id=545; https://www.flickr.com/photos/carlosfpardo/3794671537/in/pool-transmilenio/

The Transmilenio has been growing since its inauguration in 2000. In 2009 a second phase was launched, followed by a third phase in 2012-2013. Transmilenio has been highly politicised since it involved large public funding (40% by the city, 60% by the nation) and parts of it are funded through international development banks (World Bank, Inter-American Development Bank). The total expense is estimated to have been in the order $ 3 billion.

The SITP feeder bus system has achieved a good integration with adjoining areas, and reduction of emissions due to the elimination of old and dilapidates buses. In 2019, the system is under further stress, since a large tender is going to bring in a large number of replacement vehicles. The debate of this expansion of the system is focused on the environmental characteristics of these buses. The city administration has opted for the cheaper diesel technology while other cities, like Cali, have already procured electric bus fleets are working on its expansion. Given a growing air pollution crisis in Bogota, the criticism of cheaper and less environmentally friendly buses seems quite adequate.

The 2019 expansion of the Transmilenio must also bee seen in the context of other transport innovations which have great impact for the transformation of Bogota as a whole. In early 2019, Bogota inaugurated the public cable car into Bolivar City, a vast southern informal settlement which had been mostly disconnected from public transport for many decades. Since 2018, Bogota has obtained financing for its first metro line, with 70% financing from the nation, and 30% of own funding. The first section of the metro is scheduled to be inaugurated in 2024. The future metro will complement the Transmilenio, and will reduce some its load. Transmilenio will then become one of the building blocks of a truly integrated intermodal transport system which is still lacking in Bogota.

SUSTAINABLE MOBILITY PLAN FOR SAN ISIDRO-LIMA, PERU

During the last decade of rapid population growth, and wide urban sprawl of Lima, the public transport system has produced poor transport and progressive decay in public transit.

San Isidro, a dynamic and rich district in Lima and the financial centre of Lima, has seen an important growth in public transport crossing through San Isidro. In 2016, the municipality of San Isidro approved an urban mobility policy, intended to address existing transport problems. The plan is geared towards an integrated approach of remodelling public spaces, redesigning road intersections and road profiles, sidewalks, urban furniture and traffic lights and signage.

As short-term goals it set out with publicity campaigns to sensitise traffic users, and to guarantee the restitution of the rights of pedestrians and cyclists. For the medium-term the plan seeks a consensus for a sustainable transport plan which improved the quality of life of the citizens of San Isidro, and increases its competitiveness at the metropolitan level. Among the specific targets is the increase of public transit, and the use of no-motorised transport. The use of the private car is to be reduced and disincentivised, parking to be directed to designated parking areas, and providing opportunities of accessibility for all users.

Plan de Ciclovías en San Isidro

Source: Plan de Movilidad Urbana Sostenible 2016-2018, Gerencia de Sostenibilidad, Subgerencia de Movilidad Urbana, noviembre 2016

So far, the Plan has achieved a substantial increase in the network bicycle routes, by 19km, and public spaces have been improved, and parking has been restrained in public open spaces. Both public parks and public car parking facilities have been redesigned in the spirit of the new plan. Some 50 companies have subscribed to the public pact for urban mobility which subscribes to the reduction in motorised traffic and an increase in non-motorised mobility. As a new service, an electric feeder bus route has been created ("MiBus") for the employees of the offices and banks in San Isidro. These measures have gone ahead despite the objections and resistance of the Lima municipality during the 2014-2018 period, and the resistance of notorious car users who felt threatened by the restrictions in free car movement.

The system of public bicycles for rent, instead of being a system covering metropolitan Lima had to be limited to San Isidro only. The creation in 2018 of the unified Urban Transport Authority for Lima and Callao (Autoridad de Transporte Urbano para Lima y Callao), under the Ministry of Transport, may lead to a more positive reception of the progressive policies of San Isidro´s mobility plan.

CHAPTER T 4

SUSTAINABLE BUILDING

SUSTAINABLE BUILDING

Another key sector for sustainable cities, besides clean energy and green transport, is sustainable 'green' building which can impact 30-40 of current city emissions of co2. Green building is rapidly becoming an industry trend, and is receiving much attention by the private sector and corporate-institutional and private building owners. A consolidated body of experience with green building exists in Europe and is emerging in LAC countries. Since the climate in the LAC region is very varied, different cooling or heating approaches need to be applied. Energy efficiency requirements like in Europe are not fully suitable for the tropical or subtropical regions of the LAC countries. Since the LAC region has many distinctive climate zones, there is ample need to develop passive building design concepts further to service warmer and hot climate zones, and equally through passive building technology in cooler regions of the south of the South-American continent which has very different circumstances. To achieve higher energy efficiency targets, the attention has even shifted to more ambitious energy-efficiency targets of building that produce the energy which they consume. The principle of active building design, or near-zero energy buildings is relevant to convince those who are still doubting the relevance of energy-efficient building. Since a large share of the existing building stock has a reasonable life expectancy, there is need for retro-fitting of these buildings to bring them at par with new buildings through upgrading or retrofitting measures.

SECTOR PROFILE AND INTRODUCTION

As one of the most visible features of sustainable cities, a movement of green building has emerged internationally. There has been a big surge in energy-efficient engineering and construction technologies, and governments have taken the lead in designing tax incentives and stricter building codes for retrofitting and new construction. More so than ever, the contribution of buildings to the co2 performance of cities is being recognized. Buildings contribute about 40 to 50% of urban co2 emissions through the type of construction materials used—and carbon consumption in manufacturing these—, their construction related cooling or heating requirements, their energy requirements for services like water supply, waste water and solid waste disposal, and their general energy efficiency. Tackling the energy demand of existing buildings is, therefore, a high priority on the path to green cities. Their conversion to greener buildings should start with the building materials and later extend to their internal infrastructure systems of water supply, cooling and heating systems, and their processing of waste water and solid wastes. ¨Passive¨ (and ¨active¨) design solutions, as already proven by many innovative projects, have improved their energy performance.

KEY ACTIONS BY CITIES TO FURTHER GREEN BUILDING

A recent study of the Ross Centre for Sustainable Cities at the World Resources Institute has identified eight actions for urban leaders, on how to accelerate building efficiency.[16] The options for local government actions to improve the energy efficiency of the built environment fall into eight categories:

Eight Green Building Action Cities Can Initiate:

approaches	impacts
Building codes and standards:	Uniform requirements for new and existing structures ensure a "minimum level of energy efficiency". Building codes promote long-term savings.
Energy-efficiency targets:	Municipalities can set mandatory energy-reduction goals for city-administered buildings and voluntary benchmarks that apply to all other structures.
Measure and track performance:	Audits, certification programs and disclosure requirements are among the tools cities can use to measure the energy performance of buildings.
Financial incentives:	Grants, rebates, mortgage financing, loans, credit lines and tax incentives are some approaches cities can introduce.
Lead by example:	City governments can initiate policies and projects that set an example for the community and foster greater acceptance and demand for energy-efficiency solutions. Start with city-owned buildings.
Engagement strategies:	Competitions, and awards that facilitate feedback are ways to spur dialogue among tenants, building owners and management.
Technical training:	Educational programs to develop skills to implement the latest energy conservation designs and innovative financing.
Partner with utilities:	Widen access to energy usage data through alliances with local utilities. Make smarter decisions about energy efficiency goals.

Adapted from: Becqué, R., Mackres, E., Layke, J., Aden, N., and Nate Aden, and Sifan Liu. 2016. Accelerating Building Efficiency – Eight Actions for Urban Leaders. World Resources Institute. Ross Centre for Sustainable Cities. Washington. www.wri.org/buildingefficiency

INNOVATION IN THE SUSTAINABLE BUILDING SECTOR IN THE LATIN AMERICAN AND CARIBBEAN REGION

Like in other part of the world, many cities in the LAC region are modernizing their building standards and construction industry guidelines. Argentina, Chile[17], Colombia and Mexico have shown biggest advances. 'Bioclimatic' or solar architecture has become a new field of research and teaching at universities, and the ministries of these countries are developing guidelines. Mexico with the help of German technical and financial assistance has embarked on a green building finance scheme for its mass housing. 'In Mexico, KfW and the Inter-American Development Bank support INFONAVIT and the Sociedad Hipotecaria Federal (SHF) promoting green homes in the social housing category under the label of the EcoCasa. The program works with private developers; technical capacity-building for developers is provided to help them integrate

16. Becqué, R., Mackres, E., Layke, J., Aden, N., and Nate Aden, and Sifan Liu. 2016. Accelerating Building Efficiency – Eight Actions for Urban Leaders. World Resources Institute. Ross Centre for Sustainable Cities. Washington. www.wri.org/buildingefficiency

17.http://www.archdaily.co/co/870286/construye-solar-2017-inaugura-en-chle-su-villa-solar-con-prototipos-sustentables-de-viviendas-social?utm_medium=email&utm_source=ArchDaily%20Colombia

sustainability into their business models'. [18] Sustainable green construction is certainly considered an interesting innovation for the construction industry as can be seen in all countries. However, currently, most green building products are aimed at the upper sections of the construction market. Low-income housing and construction of poorer segments of society are not yet covered, and due to the massive share of informal building an outreach to these strata of society will certainly take more time.

EXAMPLES SHOWCASED

The examples selected to showcase the sustainable building sector innovations are (i) home retrofitting programme in Bariloche, Argentina; (ii) energy-efficient corporate building of the Brazilian National Confederation of Municipalities (CNM); (iii) energy-efficient housing programme of Chile; (iv) bio-climatic building of a university building in Colombia; and (v) the Peruvian programme for the promotion of green buildings and green roofs in San Borja, Lima in Peru.

COUNTRY	TITLE	LINK
Argentina	Home retrofitting programme in Bariloche, Argentina	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/San_Carlos_de_Bariloche_-_Programa_Sustentabilizar_Hogares.pdf
Brasil	Energy-efficient corporate building of the Brazilian National Confederation of Municipalities (CNM)	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Bras%C3%ADlia_-_Edif%C3%ADcio_Sede_da_Confedera%C3%A7%C3%A3o_Nacional_de_Munic%C3%ADpios__CNM_.pdf
Chile	Energy-efficient housing programme of Chile	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Cobertura_nacional_-_Calificaci%C3%B3n_Energ%C3%A9tica_de_Viviendas.pdf
Colombia	Bio-climatic building of a university building in Medellin, Colombia	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Medell%C3%ADn_-_Restaurante_Corporaci%C3%B3n_Universitaria_Adventista__UNAC_.pdf
Peru	Peruvian programme for the promotion of green buildings and green roofs in San Borja-Lima, Peru.	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Lima_-_Edificaciones_Verdes_y_Techos_Verdes.pdf

18. http://www.developingsmartcities.org/2015/07/31/kfw-kickstarts-innovative-and-sustainable-housing-markets/

HOME RETROFITTING PROGRAMME IN BARILOCHE, ARGENTINA

Bariloche´s green home building and retrofitting programme is directed at existing homes of low-income families. It intends to increase comfort levels in homes which were built without adequate isolation and with little considerations for climate and energy. The programme assumes cooperation between the city administration and the concerned citizens.

Low winter temperatures and the high energy consumption for heating are the key motivation, particularly aggravated by the energy emergency which the region experiences, makes energy-efficient and more sustainable building a necessity. Some 43% of energy consumption is residential, and energy´s contribution to green-house-gas (GHG) emissions in Bariloche is about 70%. Given the poor energy performance in home of the targetted families who use fire wood which is costly and an increasingly scarce energy source, the Home Retrofitting Programme has undertaken diagnostic studies of the energy consumption of existing houses. The FOVISEE Foundation (Foro de Vivienda sustentabilidad y Energía) have based their approach on experiences from the NGO ´Weatherization Without Borders´ (WWB) in the US, to develop this project as pilot project.

The pilot reaches out to 100 homes which have received improved thermic isolation in roofs and walls, particularly those walls which receive most impact from rains and winds, plus improved windows and door, and the installation of new ventilation ducts. The city administration and FOVISEE have created for each home a protocol that documents the technical measures required and to be undertaken, and the municipal institute Land and housing (Instituto Municipal de Tierra y Vivienda para el Hábitat Social [IMTYVHS]) has trained construction workers prior to the retrofitting measures.

TYPICAL HOMES IN BARRIO NAHUEL HUE, BARILOCHE AND THERMOGRAPHIC ANÁLISIS OF ENERGY LOSSES

Fuente: Imágenes provistas por el área de Ambiente de la Municipalidad de San Carlos de Bariloche

Since the implementation of this pilot project, the decisión was taken that all homes Will be subjected to energy retrofitting by Instituto Municipal de Tierra y Vivienda.

Besides home improvement, the initiative generates new employment and capacity building opportunities under the national programme of "Let´s create the future" ("Hacemos Futuro").

SUSTAINABILITY ANALYSIS OF HOMES, APPLYING MODERN ENERGY-EFFICIENCY STANDARDS

Fuente: Sitio web del FOVISEE. https://www.fovisee.org/proyecto/sustentabilizar-hogares/

The retrofitting activities and capacity building were mainly funded the budget of the implementing agency (Instituto Municipal de Tierra y Vivienda para el Hábitat Social) and FOVISEE which provided technical assistance and training. The implementing agency spent about $6.000 per home.

The programme´s experience is interesting since it has stimulated inter-institutional collaboration and the creation of a municipal ordinance for sustainable building which will have impacts on future social housing schemes in the southern region of Argentina. Its impacts will go beyond the social housing segment, and reach other income classes equally as energy-efficiency will become an issue for everyone.

ENERGY-EFFICIENT CORPORATE BUILDING OF THE BRAZILIAN NATIONAL CONFEDERATION OF MUNICIPALITIES (CNM)

In 2016 the Brazilian National Confederation of Municipalities (CNM) constricted its new office building in the city of Brasilia. The building is a showcase of various aspects of building sustainability, including rainwater harvesting and reuse of recycled water, passive cooling and solid waste recycling. Sustainability was considered due to the long-term cost advantages these environmental features offer. These savings in operational costs are to the benefit of CNM, and the environmental impacts are an advantage for the city of Brasilia.

Headquarter of CNM
Source: https://www.galeriadaarquitetura.com.br/projeto/mira-arquitetos_/nova-sede-da-confederacao-nacional-dos-municipios/1199

Sustainability aspects of the CNM building:

- 100% of its used waters are recycled and used for gardening or car washing.
- Rainwater is caught.
- Smart water management causes water savings and manages the partial cleaning of used water effluents prior to reuse. In practice it means that toilet water at times may be a bit darker than fresh water. It implies substantial savings in fresh water resources.
- Through educational means, CNM informs its visitors about these smart building technologies, and thus, educates visitors about Smart water management techniques.
- The vegetation of native plants in the surroundings of the building contribute to the preservation of the local biodiversity, and helps to enhance shade and favorable microclimate.
- The water body in the entrance area of the building contributes to cooling in Brasilia´s dry climate, and influences the comfort of the building´s entrance area.
- The double curtain shading device ("Brise soleil") functions as a "passive" thermic protection which protects the interior of the building.
- The plant coverage on the building´s plot offers acustic protection and enhances the passive cooling features of the architecture.
- The interior curtains ("persianas") reinforce the thermic performance due to reflection of heat. The reflect light and reduce heat which may enter the building.

- The location of the building on its site, helps to maximise shade and creation of comfortable outdoor spaces, for visitors and staff.
- Waste recycling is proceeded by waste separation (dry and organic wastes). Dry wastes like paper, plastic, metals, glass are separated, and passed on to waste recyclers.

The CNM building which has been awarded an award for its sustainability features, is a landmark in the world of office and corporate buildings. Its unassuming external feature hide many sophisticated features of passive comfort control and smart usage of natural resources. As such it represents an important advance in Brazil´s institutional architecture which is known for big gestures but less for its sustainability or environmental sophistication.

Entrance area of CNM

Water near entrance area of CNM

Source. https://www.galeriadaarquitetura.com.br/projeto/mira-arquitetos_/nova-sede-da-confederacao-nacional-dos-municipios/1199

ENERGY-EFFICIENT HOUSING PROGRAMME OF CHILE

This national programme of Energy-Efficiency of Housing (CEV) is a service that is available to interested households. Designed in 2012 by the Ministry of Housing and Urban Development (MINVU) it offers the opportunity to design new buildings or retrofit existing ones according to energy-efficiency standards.

Logos of the CEV
Fuente: http://www.calificacionenergetica.cl/

During the energy performance assessment MINVU Works with experts from the Ministry of Energy in determining thermal comfort factors, energy consumption levels which reflect heating, cooling, lighting, and warm water use. The evaluation provides as a result a colored chart with scores (letters A+ to G) as also used for electro-domestic equipment. These scores describe the energy performance of a housing unit during use, the percentage of possible savings, and energy requirements (needs) as per climatic zone where the housing unit is located.

MINVU administers and maintains this CEV assessment service, and it recommends registered professionals which undertake the assessment and authenticate the information submitted for qualification. Thus, the actors involved are the building user/owner, the CEV evaluator, and the supervising authority (MINVU). There are two type of qualifications – "pre-certification" and "certification". The first one is done prior to construction, and the second is done when a building has been completed and handed over. The assessment has a validity of 10 years, until changes in the system´s parameters may apply.

Energy-efficiency Performance Scores of Housing

CEV Sticker

Fuente: http://www.lebchile.cl/calificacion-energetica-de-vivienda/

The scores related to the letter A reflect the máximum energy-efficiency which can be achieved, and it shows a high leve lof efficiency. The letter G indicates no energy-efficieny, meaning that no insulation has been applied, or no energy-efficent equipment is in use (www.calificacionenergetica.cl).

The parameters of the assessment include: (i) thermal performance of the building envelope, (ii) radiation and its influence, (iii) internal energy use, (iv) air circulation, (v) energy use by heating devises and water heaters, (vi) impact of renewable energy and non-conventional energy sources. The CEV users receive a written report and a sticker which both summarise the results of the process.

The system has its value for voluntarily determining energy savings. Its limitations are, however, the very voluntary nature. As long as energy certification is not obligatory, or as long as no fiscal or subsidy mechanism is linked into the CEV system, its dissemination and use may remain limited. Since 2018, a new version (2.0) is in use which includes the use of solar protection measures, more precise measuring, and nine different climate regions.

BIO-CLIMATIC BUILDING OF A UNIVERSITY BUILDING IN MEDELLIN, COLOMBIA

In the city of Medellin, the construction of a university building in earth construction technology represents a special achievement. In 2004-2005 the Tierra Viva Foundation has showcased this earthen architectural experiment. The case is of a particular interest since it demonstrates in the middle of this modern metropolis that earth can still be a valid proposition of ecological urban buildings.

The Polivalente Hall of the Adventist University of Colombia (UNAC), financed by the university, was designed by architect Jesús Moreno. It is meant to represent an answer to the question of viability of traditional building materials in a modern context, and an alternative to industrialised building materials like cement, steel and brunt bricks.

Polivalente Hall
Fuente: https://fundaciontierraviva.org/tag/diseno-arquitectonico/ and Photographs by Juan José Cardona

The use of earth as a building material implies environmental as well as economic benefits. A similar version in bricks and concrete would have costed 30-35% more. Since earth building is consistent with the national building standards (NTC 5324) it complies with established criteria for durability. However, the use of earth materials signifies significant les carbon emissions. Since the earth-cement building blocks were pressed on-site, using the Cinva ram for earth construction, it was able to reduce costs for transport of materials and construction waste generated on-site. The architectural features applied, wide roof overhands protecting the walls of the building, makes it a viable architectural alternative in a location with frequent and heavy rains. The use of earth a building material reduced the carbon footprint of the building, and costs have resulted substantially cheaper than conventional buildings. 55% of the earth material used was simply extracted on the building site itself. However, the national building code (NSR-10) does not recognize modern earth buildings nor traditional versions of it.

Building with earth represents an interesting alternative in the context of sustainable development projects, and is a valuable contribution to creation of a built environment in harmony with the ecology of Colombia. While in France and Germany, modern earth buildings were fashionable in the 1980s, in Colombia the use of this traditional building material is a novelty.

PERUVIAN PROGRAMME FOR THE PROMOTION OF GREEN BUILDINGS AND GREEN ROOFS IN SAN BORJA-LIMA, PERU.

In the district of San Borja urban densities are increasing rapidly in the 21st century. San Borja´s Development Plan for 2017-2021 has defined the need to develop a city of low-carbon features. This is in line also with the municipal ordinances which aim to improve air quality, and achieve low-carbon development. Thus, the promotion of green buildings has been at relatively low costs for the municipality, as it only involved building licenses. Various studies in Lima have shown that the trade mark of a sustainable building carries 16% higher rental incomes. [19] Thus, San Borja´s greening strategy, includes green buildings.

To incentivate green and sustainable construction, the district of San Borja offered additional floor space up to 12 floors for commercial buildings and 8 floors for residential buildings, beyond the normally allowed height limits, and this in particular when such green building projects are located along main roads or avenues, or at a corner of a block. In terms of floor space area ratio this is also very attractive since it permits 80% plot coverage. Other terms are just as attractive: 3m distance form the neighbouring plots, and 60% of the open space to be used as green areas, with trees planted. The ruling for facades prescribes that at least 50% need to be windows, and the remainder green walls. Roof are to be developed a s green roofs, as is a standard provision now for San Borja.

Green walls. The frame and support structure to be erected in aluminium and steel. Insulation shall be implemented with strong materials, like recycled plastics which are able to support the green facades. Supportive structures are recommended to be made of textile membranes which can provide stability to vertical gardens and can retain humidity. Such facades need to integrated plant watering systems. A 50% share of the roof areas shall be green roofs, and green buildings shall obtain international certification (EDGE, LEED, BREAM o DGNB) to secure good marketing opportunities. All buildings are to use waste segregation at the source.

Torre del Arte, San Borja

Torre del Arte, San Borja

Source: Valverde, Guillermo. (2018) Conferencia de Promoción de Edificaciones Sostenibles. Lima.

19. El Comercio (9 de septiembre, 2017). Edificios verdes: el reto de la construcción sostenible. Recuperado de: https://elcomercio.pe/suplementos/comercial/zona-inmobiliaria/edificios-verdes-reto-construccion-sostenible-1003014

These modern, green building investments are a demonstration of new a new building typology which apply energy-efficiency principles, and contribute to a cleaner environment in San Borja. By May 2018, an additional 12 green projects, with 86,289.86m2 of new certified green building spaces were under construction. In 2017, the municipality of San Borja received the Award for Creative Business promotion, thanks to this Programe of promotion of Green Buildings and Green Roofs.

Building with Green Roof in San Borja
Source: Valverde, Guillermo. (2018) Conferencia de Promoción de Edificaciones Sostenibles. Lima.

The performance of these buildings which are labelled as green buildings, is not uncontested. Since there is the use of water, or other resources is not covered in the certification process, the question remains whether these buildings are really green buildings asper international standards. The use intensive use of air-conditioning equipment suggests that the interior of these buildings may not yet be sufficiently balanced, and that further monitoring of their green performance may be required.

The urbanistic model of high-end, high-density buildings in a district of much lower density illustrates the success of real estate development, but necessarily the success of green building.

CHAPTER 5

URBAN RENEWAL AND REVITALISATION

URBAN RENEWAL AND REVITALIZATION

Across Latin America and the Caribe we can see the adoption of urban renewal measures inspired by overseas, mostly European city innovations. Retrofitting of old, existing building stock seems to be supported by economic rationale. However, the unprecedented urban wealth rather has encouraged the destruction and many older neighbourhoods and built environments. With the greening of the building sector, the challenge arises if the can be a green, energy-efficient retrofitting of entire neighbourhoods. Urban renewal is recommended through environmental measures, through measure which revitalise the local economy, and the technical retrofitting of the building stock and infrastructure. Many cities in the LAC region have undergone wholesale transformation of their urban economies, a phenomenon that has typically led to a dramatic shift in the composition of economic activity and the spatial pattern of land use in the urban core. The historic areas of such cities become transformed into tracts of land, highly valued by commercial users. This typically leads to continually increasing pressure to eliminate any remaining vintage housing stock. Most cities in the developing world have paid—and continue to pay—very little attention to urban renewal and revitalisation of their historic urban core areas, and the housing stock therein. As a result, these areas continue to decline, both in terms of their overall quality and their potential contribution to the city's housing market and overall economy.[20]

DEFINING URBAN RENEWAL AND REVITALISATION

In recent years, urban renewal and revitalization have emerged as important issues in urban planning and design, mainly because of the economic, cultural, technological, and physical benefits it confers. In this context, "urban renewal" refers to comprehensive reinvestment in the social, economic, cultural, and physical infrastructure of urbanized areas. Urban renewal is not only as a necessary and permanent part of the transformation of cities, but it is also being argued that urban renewal and revitalisation or 'preservation' gives an important stimulus for cities. [21]

Urban renewal has been described as the intention to recover idle investment, employment, and consumption and to enhance the quality of life within urban areas. [22] Others have added "growth" and "progress" to the definition of what they refer to as "urban revitalization" and stated that, as with earlier labels (e.g., "urban redevelopment", and "urban regeneration") urban revitalization implies growth, progress, and infusion of new economic activities into stagnant or declining cities that are no longer attractive to investors or middle-class households. [24] This process of continuous transition occurs largely in response to the political, industrial, economic, and social changes· [24]

URBAN RENEWAL REVALIDATES NEGLECTED AREAS

Benefits of urban revitalization can be seen in its contribution to cultural education. Architectural heritage can play an important role in education. Today, when visual appreciation and first-hand experience play a decisive role in education, it is essential to keep alive the evidence of different periods and their achievements to provide a wealth of material for explaining and comparing forms, styles, and their applications (European Charter of the Architectural Heritage 1975). [25] It must also be remembered that historic cities rarely are made of buildings dating from the same age, but they rather evolved incrementally over decades if not centuries. Therefore it is fully justified to complete a historic plan with high quality modern buildings as long as they respect the scale and townscape of the environment.

20 Inter-American Development Bank. 2017. Urban Revitalization: Assessment Methodologies and Expected Impacts. Washington. D.C. file:///C:/Users/Admin/Downloads/Urban-Revitalization-Assessment-Methodologies-and-Expected-Impacts.pdf

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STATE OF THE ART IN URBAN RENEWAL AND REVITALISATION IN LAC COUNTRIES

LAC cities' urban extension has drawn in recent years again the attention to urban renewal and revitalization, especially in historical cities. Many LAC cities still have a historic city centre left, though such historic urban areas may be rapidly disappearing under to the pressures of real estate development, or the influx of migrant workers which bring their village to the city.

URBAN RENEWAL MAY NOT COVER ENTIRE CITY CENTRES, BUT ONLY PILOT PROJECT AREAS

Even in developing countries where urban renewal and revitalization has been attempted, such efforts are usually conducted only on a small scale and often focus on the most profitable projects, such as those portions of historic areas with tourist potential. This, in parts, reflects the widely held view that tourism is often the sector with the greatest potential for rapid growth in national income. Once the decision to revitalize a historic urban area has been taken, the participation of current residents and other stakeholders is of utmost importance for the success of the venture. It goes without saying that the impact of conservation of historic towns and urban areas affects the life of the local residents in the first place. In return, their active support, or resistance, can make the difference between success or failure of an urban renewal venture. Hence, early consultation and inclusion of the resident population is mandatory in any such initiative.

ADAPTIVE REUSE AND COST RECOVERY

A key concern is raising the funds necessary for securing the necessary dynamics of initiatives from the start right through to completion. One approach to raising such funds is adaptive reuse. Under this approach, private entities and/or nongovernment institutions are allowed to lease historic facilities for commercially viable uses that respect and upkeep their historical value apart from earning a profit from the use of the facilities. However, adaptive reuse is not a universal solution to the problem of financing urban revitalization initiatives. Its usefulness is often limited when dealing with listed monuments and heritage objects, since these, while requiring expensive restoration works and being restricted from fundamental architectural adaptations, usually generate only modest revenues. Investments in monuments and related heritage objects thus often require not only political backing, but also financial support in form of tax incentives, loans on concessional terms, free leaseholds or even subsidies.

COMMERCIALIZATION OF HISTORIC CITY CENTRES

Few cities have followed an entirely commercial model in revitalizing historic urban areas. Cartagena provides one example of this approach: The historic city centre has been rehabilitated through private efforts. Cartagena's experience is that urban revitalization leads to a significant increase in property values. Rehabilitation of the Cartagena's historic centre mansions have caused property values to increase tremendously, and completely changed ('gentrified') the social fabric. [26]

26. Centros Historicos: deuda con el pasado, oportunidad para el futuro, en: Portafolio 15 Noviembre 2015; see also: http://www.eluniversal.com.mx/entrada-de-opinion/colaboracion/luis-alberto-moreno/cartera/2015/11/16/centros-historicos-deuda-con

EXAMPLES SHOWCASED

The examples selected to showcase the sustainable building sector innovations are (i) renovation of commercial zone in San Isidor - Buenos Aires in Argentina; (ii) revitalisation of the Porto Maravilha, Rio de Janeiro in Brazil; (iii) a neighbourhood upgrading programme "Quiero Mi Barrio" ['I love my neighbourhood'] in Temuco, Chile; (iv) Downtown urban renewal in Pereira's Ciudad Victoria in Colombia; and (v) The restauration and adaptive reuse of a Tambo in the centre of Arequipa in Peru.

COUNTRY	TITLE	LINK
Argentina	Renovation of commercial zone in San Isidro - Buenos Aires, Argentina	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_San_Isidro_-_Renovaci%C3%B3n_del_Centro_Comercial_a_Cielo_Abierto.pdf
Brasil	Revitalisation of the Porto Maravilha, Rio de Janeiro, Brazil	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Rio_de_Janeiro_-_Porto_Maravilha.pdf
Chile	Neighbourhood upgrading programme "Quiero Mi Barrio" ['I love my neighbourhood'] in Temuco, Chile	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Cobertura_Nacional_-_Programa_de_Recuperaci%C3%B3n_de_Barrios_%E2%80%9CQuiero_Mi_Barrio%E2%80%9D.pdf
Colombia	Downtown urban renewal in Ciudad Victoria in Pereira, Colombia	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Pereira_-_Plan_parcial_Ciudad_Victoria.pdf
Peru	The restauration and adaptive reuse of a Tambo in the centre of Arequipa in Peru	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Arequipa_-_Restauraci%C3%B3n_de_un_Tambo.pdf

RENOVATION OF COMMERCIAL ZONE IN SAN ISIDRO - BUENOS AIRES, ARGENTINA

This integrated urban renewal project is directed at improvement of mobility in San Isidro, in the province of Buenos Aires. It gives a new status to pedestrians through improvements in public spaces, and adds to urban greenery. San Isidro, located in the north of Buenos Aires´ metropolitan region, is located on the banks of de la Plata river. The project emerged from a 2015 architectural competition which aimed at a renewal initiative for 100 blocks within San Isidro.

El eje del proyecto conecta dos centros claramente definidos, el centro de transportes y el casco histórico. Este desdoblamiento urbano es atípico y diferente al tradicional, generalmente conformado en torno a una única plaza. El espacio público en esta zona se interrelaciona con usos y actividades administrativas, culturales, de educación, de salud, de vivienda, comerciales, deportivas, turísticas, recreacionales, y el equipamiento urbano público.

At the center of the urban renewal proposal is the creation of modified mobility. New pedestrian zones and plazas connect points of public transport (train station, bus stations) with the commercial zones in the center.

Digital images of the renewal Project

Source: Estudio Lacalle Martínez Vallerga. http://arqa.com/arquitectura/urbanismo/renovacion-urbana-del-area-centro-de-san-isidro.html

The so-called Open Comercial Centre ("Centro Comercial a Cielo Abierto [CCCA]) seeks to revitalise the commerce of San Isidro. The new urban design introduces new features which strengthen spatial cohesion and connectivity. The proposed pedestrian zones and the underground parking facilities generate new patterns of movement in the center, reduce car movement and truly pedestrianise the center. A new downtown square is supposed to enhance the connectivity between transport stations and add additional commercial spaces. The new greenery along the pedestrian zones modifies the environmental features of San Isidro and creates a new image of the center with a dominant green appearance.

The project´s architectural competition has triggered many urban design ideas, and there is a consensus about the merits of the project. The project is to be financed by municipal revenues originating from parking fees. But as these funds may not be sufficient, the municipality seeks to generate additional private funding support and private investments.

REVITALISATION OF THE PORTO MARAVILHA, RIO DE JANEIRO, BRAZIL

Rio de Janeiro has well-known architectural heritage value. Its port area is one of the most historically relevant entrances to Brazil. In the 1970, the perimeterl road transformed this area and created a separation between the city and the port area.

The recently created Porto Maravilha aims to reverse this situation through the creation of a cultural attraction in the form of the ´Museum of Tomorrow´ a science museum in the city of Rio de Janeiro, Brazil. It was designed by Spanish neofuturistic star architect Calatrava. The idea is to replicate the ´Bilbao effect´ which the Guggenheim museum had on the Spanish city of Bilbao.

Rio de Janiero Port

Aerial view of Museum of Tomorrow

Source: http://portomaravilha.com.br/fotos_videos/g/22/pagina/2

For the establishment of this Project, the municipality of Rio de Janiero created a special purpose company for development of the port region of Rio de Janeiro, to secure financing of the project till year 2026. The New Port concessionary was created to manage and implement the investments and administer the site, including infrastructure (water, waste management, public lighting, gas, and telecommunications). The preparations of the project involved the demolition of 4.790 meters of the elevated perimeter road, and replaced it with a new mobility concept creating new access roads, access to the city highway (via expressa) and new bicycle lanes to connect this new urban hub. These mobility investments have complete altered the existing transport arrangements by integrating public and private motorised transport (metro, train, buses, airport links, cruise ship terminal, and the forthcoming Transbrasil bus rapid transit system) with non-motorised mobility (walking and cycling). The new opens paces and mobility infrastructure has been complemented by 15.000 newly planted trees.

Besides the new transport infrastructure, the principal works implemented are the new Museum of Art of Rio (MAR), and the museum of Tomorrow - a new showcase project of an experimental and interactive museum. This urban renewal project revalues the historic port area.

The commitment of the city with this project is highlighted by the fact that 3% of its funding is generated by the sale of development rights to building owners who are now allowed to densify their existing properties. The revenues from the sale of the building rights were used to fund the operations of the infrastructure of Porto Maravilha.

The expected impact of the revitalization is that the population will grow with in the next 10 years (from 32.000 to 100.000) and that traffic flows will increase by 50% transforming the economy of this downtown area of Rio de Janeiro. The new transport infrastructure will ensure that noise pollution will be reduced, and that heavy transport of good will be reduced, giving emphaisi to the spatial integration of the area. The project will be an important contribution to the immaterial (historic) heritage of the city. Important national and international companies are associated with the project and generate the economic vibrancy required for the revitalization of the surrounding neighbourhood.

NEIGHBOURHOOD UPGRADING PROGRAMME "QUIERO MI BARRIO" ['I LOVE MY NEIGHBOURHOOD'] IN TEMUCO, CHILE

"I love my neighbourhood" is the name and motto of this urban renewal programme of the Ministry of Housing and Urban Development (MINVU). Established in 2006 as an initiative of the President, it has launched participatory processes of neighbourhood improvement and revitalisation. Its features are directed at neighbourhood identity, heritage, social inclusion, and citizens´ participation.

The revitalization process starts with an application to MINVU by the neighbourhoods or municipalities to participate. The programme has an operations manual which guides the preparation of a master plan which is to be developed by the neighbourhood development council (Consejo Vecinal de Desarollo [VCD])

In Temuco the neighbourhood of Amanecer and its recreational ´Venecia´ park was selected. The park has an extension of 8.400m2. Under the project additional equipment and outdoor furniture for picnics, infrastructure (drainage, event space) was developed.

Aerial view of the Venecia park, Temuco

Soruce: Rodrigo Meza https://www.plataformaarquitectura.cl/cl/766235/venecia-recreational-park-jaime-alarcon-fuentes

So far, the programme has been implemented in some 128 communities in 15 regions of Chile, and since 2018 another 50 projects are under development. More than 1 million people have benfited from the project, and more than 2.200 subprojects have been completed. 138 ha of green spaces have been developed, and 220 sport centers been constructed and 820 sets of outdoor sport equipments been installed, and some 850.000 UF been invested in home improvements of adjoining areas. In 2015, the programme was awarded a best practice award by UN-Habitat in its annual Dubai habitat awards.

DOWNTOWN URBAN RENEWAL IN CIUDAD VICTORIA IN PEREIRA, COLOMBIA

Pereira´s downtown area was heavily affected by the 1999 earthquake in the coffee zone (Armenia, Manizales, Pereira). Old buildings and in particular the old municipal market suffered heavy damage. The renewal of this central area was designated as an economic intervention intended to boost the economy and wellbeing of the population of the centre. The main investments were the creation of a large civic and cultural centre (Centro Cultural Lucy Tejada with 5.800 m2), commercial facilities (Ciudad Victoria mall, supermarket with 30.000 m2, commercial facilities, 900 parking spaces, a large open square for events (6.500 m2), renovation of some historic private and public buildings, and linear park (Parque Lineal Egoyá [10.668 m2]).

Centro Cultural Lucy Tejada, Ciudad Victoria

Ciudad Victoria

Source: Imagen por Laura Amaya Gallo

The Project was funded through public and private investment. The municipality funded 19% of the total of $57.920.722 investment, while the private sector contributed the remaining 81% ($46.711.760). The Inter-American Development Bank funded $10 million of the public and $40 million of the private investments.

To attract private investments, the municipality used 10-year tax exemptions, and provided tax breaks of one to five years for commercial entities, as well as property tax exemptions for the first five years and 100% tax exemption for private residential construction. Large companies like the Exito supermarket chain, and the phone company (Telefonica de Pereira) located in Ciudad Victoria and ensure a steady stream of visitors. The Megabus – Pereira´s public rapid bus transit (BRT) crosses through Ciudad Victoria and ensures good connectivity.

Some adjoining areas which are still empty, due to property disputes, are yet to be developed and included in the Ciudad Victoria development. Expropriation has been envisaged as one possible approach to these to finalise the renovation of Ciudad Victoria.

THE RESTAURATION AND ADAPTIVE REUSE OF A TAMBO IN THE CENTRE OF AREQUIPA IN PERU

In Peru`s second largest city of Arequipa the historic city center is recognized by UNESCO as cultural heritage. The center has 273 houses which are declared monuments, mostly originating from the 18th century, and another 187 historic buildings awaiting such classification. Among these there are Tambos built by the Incas or later during colonial times. These Tambos served as temporary accommodation, and for storage of goods and materials of travellers and traders.

The restauration of Tambo La Cabezona was coordinated by the office for the historic City Centre, a group of architects from management group of the historic city center and monuments zone, and the municipality of Arequipa. The same group had already restaoed other tambos. The works at the decayed tambo were conducted between 2005 and 2010, and it was possible to retain the same population groups without forcing them to relocate.

The tambo was built in sand stone (`sillar`) in the construction method of the colonial period. Initially it was part of the water mills along the river, but over time its role changed. After the 1893 flooding, the water mill remained destroyed, and during the 1958 and 1960 earthquakes it suffered seriously, affecting its habitability. The flood events caused that the building sank by 1.2m into the ground. The 2001 earthquake added structural damages, and the stairs and mud walls got serious cracks.

Tambo La Cabezona – before restauration

Tambo La Cabezona – after restauration

Source: Carlos Zeballos, Arequipa

During the reconstruction, unstable elementes were replaced, and so were the old and deficient infatsructure netwroks (wáter, waste wáter, electricity), and finally the outdoor áreas.

The project which is meant for residential purposes pursues the objective to make the historic center more habitable and thus, making it more safe for the 82 families resident there. The restauration has improved the personal attitude towards built heritage, ad improved neighbourly relations.

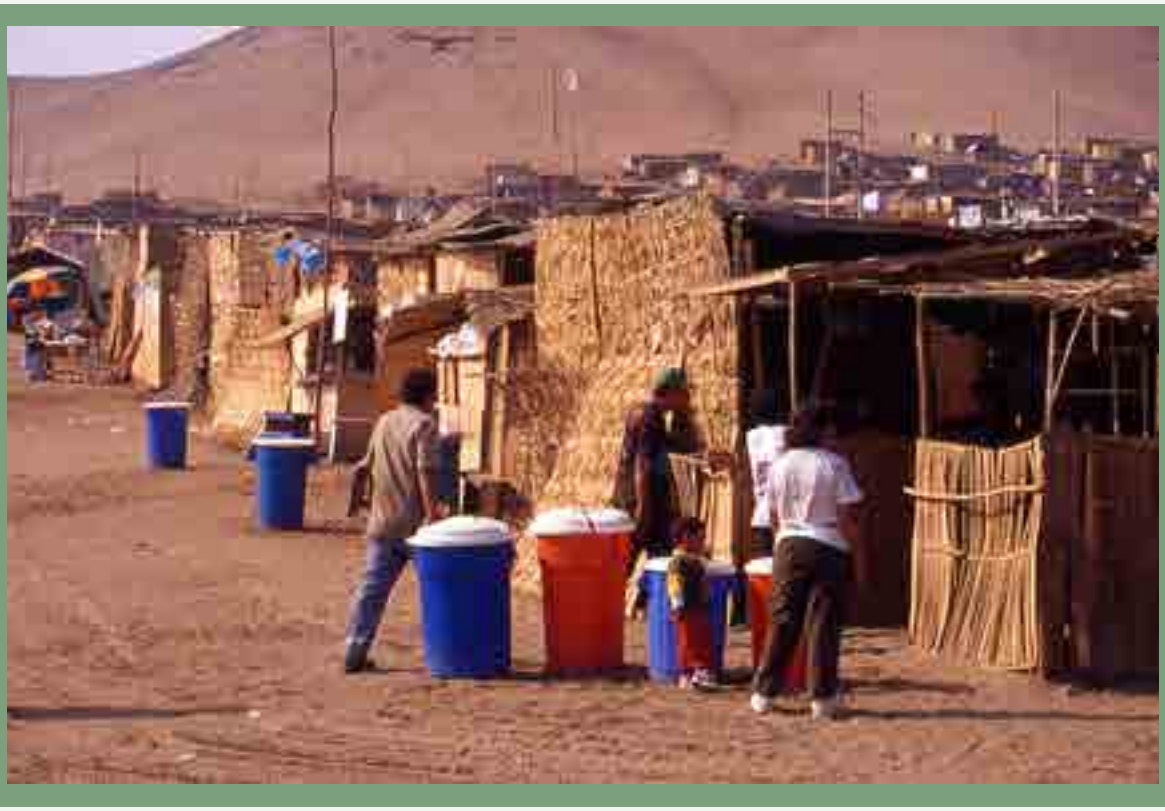
The restauration was supported financially the Spanish agency for International cooperation for development (AECID). The completed Project was awarded recognition during the XIV Bienal Nacional de Arquitectura Peruana, and was a finalist for the Rogelio Salmona award.

The nature of the project implementation was very participatory, and particularly women played an important role in its execution. The social process showed that social empowerment and development is indeed compatible with historic restoration and revitalization of heritage complexes.

CHAPTER 6

WATER MANAGEMENT

WATER SUPPLY, WASTE WATER TREATMENT AND FLOOD CONTROL



WATER IS ONE OF THE MOST IMPORTANT REQUIREMENTS OF LIFE

Since many urban areas in the LAC region are ´water-scarce´, water management (water supply, waste water treatment and flood management) is an essential part of their ecological development. Thus a prime concern is the provision of quality drinking water, ensuring water safety for all. The provision and distribution of water is a prominent factor in cities´ energy consumption, and new technologies can reduce energy needs. Immediately related to waste water is the treatment of waste water which can be done through sophisticated technologies or nature-based decentralised technologies. To address the issue of flooding through a holistic low-impact development (LID) approach, the ´sponge city´ has been conceived which covers water harvesting through non-conventional methods, the nature based treatment of waste waters, and drainage and flood management through adaptive measures.[27] Cities can save water through smart technologies, can improve water efficiency through smart storm and flood control equipment and water re-use.

INADEQUATE COLLECTION OF WASTE WATER

If sewerage networks are undersized or badly maintained then blockages and overflows occur. At worst this can cause sewer flooding and the backing up of sewage into households. Inadequate collection of waste water has a very strong impact on the natural environment. More so, the discharge of untreated effluent and industrial waste has strongly detrimental effects on the biology of watercourses and their ecosystem. Coupled with these challenges, inadequate drainage and preparedness for heavy rain events often means that wet season and instances of high rainfall are compounded by poor or absent solid waste management and exacerbate the challenges that cities face in managing water resources, as it impacted by through localized flooding, contamination of water resources (through effluent combined fresh water).

ENERGY CAPTURE FROM SEWAGE NETWORKS AND TREATMENT PLANTS

Digested sludge has been used to produce methane to power treatment works for many years. The processes are being progressively improved and optimized, in terms of the quality of the methane produced and the efficiency of the engines used to burn the methane. Sewage, water treatment and water pumping are energy intensive process so any methods to optimize this are important. These include, pump design, real time control systems and heat and energy recovery systems. The concept of carbon neutral STW is being developed, although none have yet reached this status. Significant development is continuing and this will be a major driver for future work, in terms of carbon reduction and cost saving.

NATURE-BASED SOLUTIONS

There is a growing awareness that nature can help to develop viable solutions which use and deploy the properties of the natural eco-systems, making them a new form of smart infrastructure systems, e.g. 'engineering' natural, 'green' and 'blue' solutions. [28]

27. Inter-American Development Bank. 2018. HABLANDO DE AGUA Conversación digital sobre agua y saneamiento en América Latina y el Caribe. http://www.watertech.com.co/wp-content/uploads/Hablando-de-agua-Conversacion-digital-sobre-agua-y-saneamiento-en-America-Latina-y-el-Caribe-ilovepdf-compressed.pdf
28. EU. 2016. Nature-based Solutions & Re-naturing Cities. Research and Innovation. Brussels. http://europa.eu/!BV74Vf.

SUSTAINABLE DEVELOPMENT GOALS

To meet today's water challenges countries in the LAC region will have to advance on several fronts:

- Improving the efficiency of service providers to allow them to generate more internal resources to cover costs and fund investment. This includes better collection of bills, reduction of administrative losses (clandestine connections, under-metering) and physical losses, better procurement practices, the use of low-cost technologies and a reduction of overstaffing.
- Increasing investments in water and sanitation from the current low level of 0.15 percent of GDP. Investment needs are estimated to exceed 0.2 percent of GDP.
- Introducing innovative mechanisms for commercial financing. This includes tapping domestic capital markets where feasible and the judicious use of guarantees and guarantee facilities, while managing contingent liabilities prudently.
- Targeting subsidies better and improving cost recovery. Implicit and explicit subsidies through low tariffs mostly benefit the better-off. Increasing tariffs is often a necessity. But in order to make this more equitable, such measures should be complemented by actions to enhance collection efficiency, reduce the incidence of illegal connections, increase the share of metered connections, revise tariff structures and introduce means-tested subsidies where feasible.
- Expanding access to water and sanitation services, especially to the poor, while ensuring that these services are accessible, efficient, and sustainable. Low-cost technologies such as condominial sewers can play an important role in that respect, as can legalizing land tenure and finding innovative ways to provide services to those without land titles.
- Improving service quality. Without continuous supply, reliably good drinking water quality, and the prevention of sewer overflows, health is endangered and – especially if customer service is poor and billing complaints not resolved swiftly – it is difficult to justify a higher degree of cost recovery.
- Strengthening the capacity of service providers. This is essential, especially given the high turnover of senior staff in municipal utilities as a result of frequent changes in municipal governments. It is important to make municipal service providers more autonomous, to insulate them as much as possible from political influence, and to provide training and a career path for utility employees.
- Redefining the role of the private sector in service provision. Private sector participation in water and sanitation in Latin America and the Caribbean has had mixed results. Some international operators have lost interest in the sector, sometimes citing governments' failure to abide by contracts. However, local private operators continue to play a major role in the sector, helping to improve efficiency and service quality, especially if state supervision is adequate.
- Strengthening information systems and impact evaluations. Utilities often have only very limited information available on the quality of their services and their assets. Regulators and governments often have even less, and there are frequently only rudimentary data available on how projects and programs have influenced coverage and service quality. The strengthening of local and national information systems and impact evaluations is therefore a priority for the region.
- Improving regulatory frameworks: A regulatory framework that ensures that the interests of both the consumer and the investor are adequately represented is essential. However, experience with utility regulation in the region is sobering, given the limited autonomy and resources of many regulators, as well as the limited inability of many service providers to fulfill norms set by regulators". [29]

29.http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/LACEXT/EXTLACREGTOPWATSUPSAN/0,,contentMDK:20791641~menuPK:855407~pagePK:34004173~piPK:34003707~theSitePK:855395,00.html

INNOVATION IN THE FIELD OF WATER MANAGEMENT IN LATIN AMERICAN AND CARIBBEAN REGION

Like in other part of the world, in the LAC region water supply is a key priority investment of the urban sector. While in many countries ample resources exist, the issue has been to make use of water before it runs off and disappears. Low utilisation rates despite availability characterise the situation. The national agendas promise to deal with backlogs in supply, and offer an increased level of services. Nature–based solutions for supply, for treatment, and for flood control seem to offer cost-efficient approaches. However, the impacts of climate change on the water sector are expected to be severe: more flooding for some and more draught for others. The required adaptation measures certainly will be massive in some cities.

EXAMPLES SHOWCASED

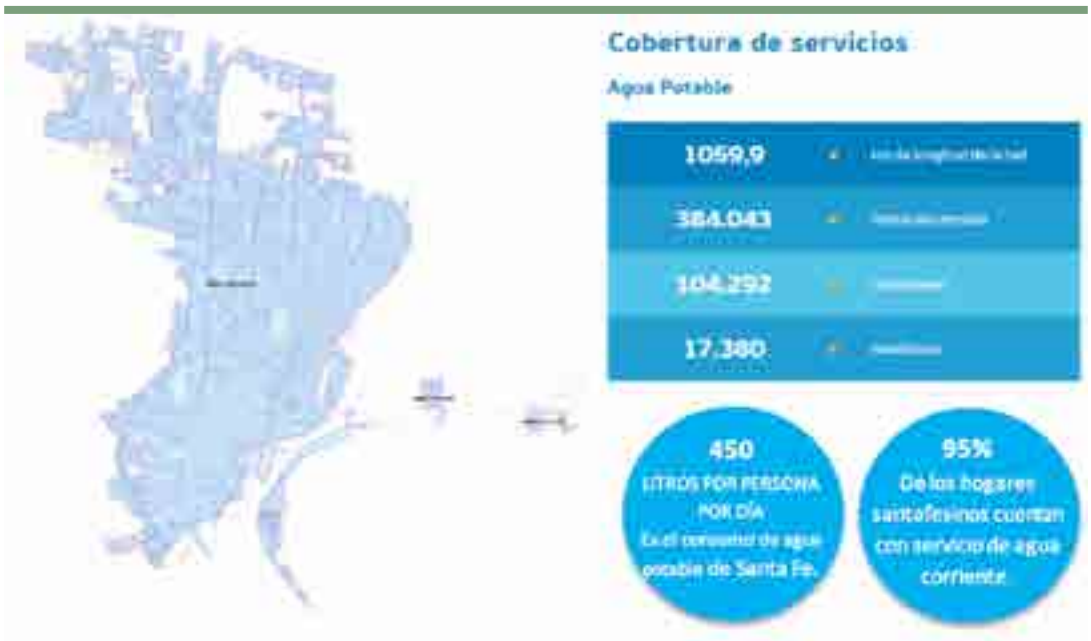
The examples selected to showcase good practices in water management are (i) safe water supply in Santa Fé, Argentina; (ii) flood warning systems in Blumenau, Brazil; (iii) the floodable 'sponge city' Víctor Jara park in Santiago de Chile; (iv) nature-based waste water treatment in Tunja, Colombia; and (v) water supply through cloud catchers in Tacna, Peru.

COUNTRY	TITLE	LINK
Argentina	Safe Water Supply in Santa Fé, Argentina	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Santa_F%C3%A9_-_Plan_de_Agua_Segura.pdf
Brasil	Flood warning systems in Blumenau, Brazil	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/3._Brasil_-_SISTEMA_ALEBARTU.pdf
Chile	The floodable 'sponge city' Víctor Jara park in Santiago de Chile	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_4_comunas_-_Parque_Inundable_V%C3%ADctor_Jara.pdf
Colombia	Nature-based waste water treatment in Tunja, Colombia	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Tunja_-_Planta_de_tratamiento_de_aguas_residuales-PTAR.pdf
Peru	Water supply through ´cloud catchers´ in Tacna, Peru	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Tacna_-_Provisi%C3%B3n_de_Agua_a_una_Urbanizaci%C3%B3n_con_Uso_de_Atrapanieblas_en_Tacna.pdf

SAFE WATER SUPPLY IN SANTA FÉ, ARGENTINA

In Santa Fé 95% of the city´s population counts on safe water supply thanks to the integrated plan for safe water (PAS). To ensure safe water supply, the system uses three approaches: (i) prevention of contamination at the sources, (ii) elimination of pollutants during treatment, and (iii) the minimization of possible pollution during storage and distribution.

The city of Santa Fe is located in the so-called ´pampa´ region, a large agricultural and industrial zone. An important characteristic of Santa Fé is that 70% of its territory is under water bodies (rivers, lakes, floodplains) which contributes to a ´mediterranean´ climate. As the city has been growing, the proximity to the water bodies has become more influential for management of the city´s water quality.



Service Coverage of Clean Water Supply in Santa Fé
Fuente: Elaboración propia en base a información e imágenes disponibles en el sitio web de Aguas Santafesinas SA. aguassantafesinas.com.ar

Control of water quality is essential for the population´s health. The measures prevent, reduce or eliminate contamination. The integrated PAS system establishes important parameters and indicators for control, and initiates measures for eventual discharge before contamination is spread. Through the concept of critical point of control (CPC) the system implements critical benchmarks and corrective measures, including a plan for action. At the start of the PAS in Santa Fe, city acquired necessary equipment for a laboratory to permit permanent testing of water quality required under the "Standard Methods for examination of water and wastewater". As second major step, a physical survey of produced water geo-referenced water samples which of clean or less clean water samples. Under this methodology, samples are preserved according to date and locations. To sustain this activity, staff was trained for extraction of samples and laboratory analysis of chemical and micro-biological contents.

The Safe Water Plan is supported by provincial resolution 1008 of 2014 and is managed by the Regulatory Entity Sanitary Services (ENRSS). The expenditures for the PAS are covered by revenues of the water company Aguas Santafesinas Fe S.A. Since the experience has been a success, the challenge will be to expand the PAS model to other locations in the province. The challenge will be to increase revenues so that the system can be funded sustainably.

FLOOD WARNING SYSTEMS IN BLUMENAU, BRAZIL

The municipality of Blumenau in Santa Catarina suffers constantly from flood events. In 2008, the valley of the Itajaí was effected by its largest natural disaster ever registered. The city of Blumenau registered 3.000 land slides and flood events. This catastrophe caused the city to start developing mitigation measures. The System for Monitoring and Warning of Extreme Events in the city of Blumenau (Alertablu) was created and supports the Civil Defense forces in its work with the communities of the city, to inform them about risk situations, and eventual temporary displacements.

Alertablu provides a set of information services and tools intended to prepare for and prevent natural disasters. Alertblu has an application for cellular phone which can handle geo-referenced localisation of flood events.

Flooding in Blumenau
Fonte: http://vitriniaberta.blogspot.com/2011/09/o-balanco-da-tragedia.html

Mobile disaster Management in Blumenau
As_tecnologias_da_informacao_e_comunicacao_na_gest.pdf

Through the site alertablu.cob.sc.gov.br the citizens have ´real-time´ access about the disaster situation in the municipality. The site has information from 17 rain metering stations, weather forecasts, rainfall estimates, data on weather history, and general forecasts for 5 days ahead. Since the information is both available on the website and in the application it offers great flexibility to users, and it offers to communicate and interface directly with the Civil Defense.

The Alertablu which is run by seven professionals, has received some R$ 7 millions, and is equipped with modern communication structures for monitoring and prevention of natural disasters. Its challenges are to become also able to react to other risks man-made disasters, and to allow more pro-active contributions from citizens and community activists.

THE FLOODABLE 'SPONGE CITY' VÍCTOR JARA PARK IN SANTIAGO DE CHILE

The floodable park of Víctor Jara in the metropolitan region of Santiago is becoming a new landmark of nine district municipalities (´comunas´) des Aguada watersheds (´Zanjón de la Aguada´) with a length of 27kms. It is the second most important water body of the city and responsible for many flood events and emergencies in many districts. Additionally, over many years the watershed has been flooded with untreated sewage which only got cleaned up after 2003 with the sewage treatment plant of La Farfana. Small informal garbage dumps aggravated the situation and turned Zanjon de Aguada into an eye sore for the whole city.

Development stages of the floodable Park of Víctor Jara
Source: Ministerio de Obras Públicas (MOP).

The project of the Victor Jara park has two aims: (i) improvement of hydraulic infrastructure, and (ii) urban renewal in the axis covering the Vicuña Mackenna road till Club Hípico, along Av. Isabel Riquelme, a total expansión of 41 ha (a length of 4.5 km). Between 2013-2017 the first stage of the project was constructed, becoming one of the biggest parks in greater Santiago, benefitting the districts of San Joaquín, Pedro Aguirre Cerca, San Miguel y Santiago.

The park project was implemented by the Ministry of Public Works (Ministerio de Obras Públicas [MOP]). Besides the hydraulic infrastructure, it wanted to create public spaces and facilities for cultural, social and sportive events, specially near the esplanade where a 53m large painting (1563m2) in honor of the singer Víctor Jara has been created. [30] Besides the obvious environmental the project has been able to provide a safe environment for some 6.200 homes, 4.700 commercial entities, 286 industrial properties, and the road infrastructure and highways. Its expenses of some $ 76 million (=$53.000.000.000 CLP) will have ide-ranging impacts. The project demonstrates the value of the "sponge city¨ concept, and that it is transferable. [31]

View of the Victor Jara Park (Stage 1)
Source: Ministerio de Obras Públicas (MOP).

30. https://www.youtube.com/watch?time_continue=727&v=baMFmenOH8o
31. https://amp.theguardian.com/artanddesign/2018/mar/21/turning-cit; https://www.thesourcemagazine.org/sponge-cities-can-chinas-model-go-global/

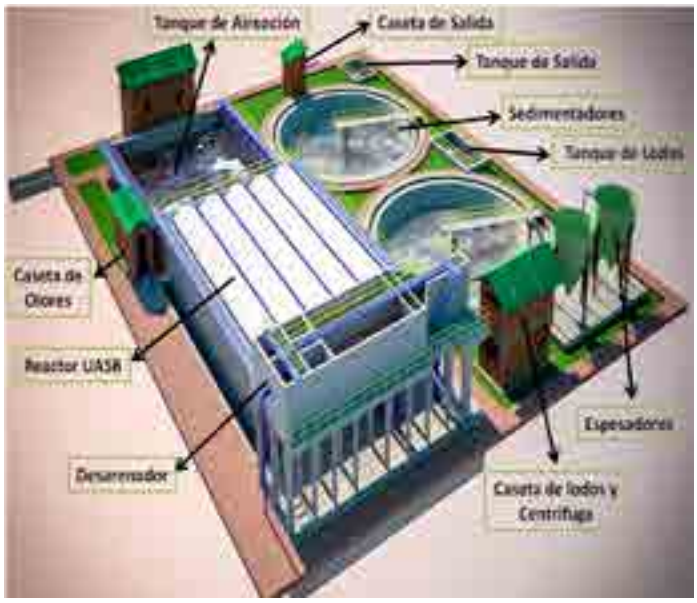
NATURE-BASED WASTE WATER TREATMENT IN TUNJA, COLOMBIA

Tunja, the capital city of the Boyacá department (province) has had a problem with untreated water for a long time. According to the Environmental Development and Management Plan (Plan de Ordenación y Manejo Ambiental [POMCA], 2006) untreated waters from homes and industries have caused the widespread contamination of the Chicamocha river basin and of the Jordán river. The POMCA had advised that the waste water treatment plants of all regions along the influence of the watersheds in the municipalities of Paipa, Nobsa and Motavita need to be covered by treatment.

The project for the Tunja waste water treatment plant was lead by the Ministry of housing, City and Territory, and was initiated in 2006. The participating municipalities of the Boyacá region, the provincial government and the regional environmental agency (Corporación Autónoma Regional de Boyacá [Corpoboyacá]) and the private water companies joined the project. In 2010, contracts were awarded, and the plant was able to initiate service in 2017.

The treatment plant consists of a modular system which allows for gowth as the city expands. The treatment is biological, consiting of a anaeróbic pase, followed by aerobic stage which is reflected in its low consumption of electricty, and its efficiency in treatment. Upon arrival, the untreated waste waters are separated into separate modules, where they will recive prliminary, secondary and final treatment. The three modules have a treatment capacity of 120 liters per second. Since the city produces about 400 liters per second in effluents, there is need for further expansion.

Tunja Waste Water Treatment Plant
Source: http://ww.corpoboyaca.gov.co/noticias/todos-unidos-por-la-recuperacion-del-rio-jordan



Components of Waste Water Treatment Plant
Source: Informe Ejecutivo Modificaciones PSMV Disponible en: http://tunja-boyaca.gov.co/apc-aa-files/39353939373461333461303765613162/2017-09junio-informe-ejecutivo-psmv.pdf

The current status of the treatment -- the investment of the first phase was about $14 million - is that about 80% of Tunja´s pollutants can be removed by this treatment plan, in its current capacity which is a good achievement. However, in a 2018 review it was found that pollutants in the Chicamocha river had been reduced to about 50%. Which is an indicator that other municipalities continue to contaminate the river. To achieve full coverage and optimal environmental impacts, a further extension of the treatment capacity is apparently necessary.

Mobilization of funding for the expansion is envisaged in the current municipal administration (2016-2019). However, the lack of treatment of waste water from other neighbouring municipalities remains a big challenge.

The fact that nature-based treatment has been applied is a relatively rare case in the context of Colombia. In many other cases high-tech solutions are being preferred since knowledge of the anaerobic and aerobic treatment processes is scarce.

WATER SUPPLY THROUGH ´CLOUD CATCHERS´ IN TACNA, PERU

The city of Tacna is located in the south of Perú, located in the high part of the Atacama desert. It is very dry and receives only about 0 to 6 mm of monthly rainfall. The Tacna region has a rain deficit of more than 8m^3 of water per second. Due to this situation, there exist high concentrations of arsen and boron. It is estimated that between 2004 – 2014, the population grew by 20%, and many citizens have no piped water supply, and have to buy water from private water tankers which provide this service at a relatively high cost.

The ´cloud catcher´ water project was developed in Los Pedregales in the outskirts of Tacna. In its initial phase (2014-2017) the first 40 cloud catchers were installed near a suburban neighbourhood. Project promoters were the Movement of Peruvians Without Water (Movimiento Peruanos Sin Agua [MPSA]), an NGO which helps poor marginalised informal settlers with innovative technologies , and Creating Water, a Dutch NGO which has specialized in ´cloud catchers. In the current phase since 2018, the initiative has sought crowdsourcing support from "Challenge – google 2017". Through this funding approach it has obtained about $500.000 from Google.

Cloud Catchers being installed

First Phase of Cloud Catchers

Harvesting Water
Creating Water in the Atacama Desert - Creating Water Foundation – Documentary

Destruction of Cloud Catchers
Movimiento Peruanos sin Agua Google Impact Challenge 2017.
https://larepublica.pe/sociedad/1007437-ong-

The first project phase was funded by the government of the Netherlands, and the second phase by google. During this project phase the first group of ´cloud catchers´ were installed, and small vegetable gardens as livelihood support were planted. However, on January 5, 2017 the project was destroyed by the police, on the ground that it was built on illegally occupied land.

The resulting situation was resolved by the gobernor stepping in with an offer of 53 ha of government land, for the further implementation of the ´cloud catcher´ project. The Los Pedregales community wants to use this opportunity to scale up the experience and to combine it with the development of sustainable human settlement which shall serve as a showcase for other desert communities.

The impacts of this project have been beyond the water for the 120 families in Los Pedregales. The project has shown that rather unconventional methods for water harvesting can be applied, and that these community-based initiatives may lead to much bigger objectives of community development. The project has won international recognition through the ´Challenge google 2017´ award (2nd place), and is now projecting itself to more holistic goal of settlement development.

CHAPTER 7

SOLID WASTE MANAGEMENT

SOLID WASTE MANAGEMENT

Due to rising living standards and consumption levels, solid waste is increasing rapidly. The current conventional standards are low, and majority of waste ends up in uncontrolled dump sites, with little recycling and reuse. These conditions call for a more integrated approach of waste management. One major underlying principle will be the introduction of waste reduction, recycling and reuse (3-R) practices. A serious fact of the waste management situation is that there exist only few waste-to-energy projects in the country, and for those that exist there are no modern technologies for their closure known. A modernization of the waste sector is urgent, and a better use of the resources through recycling or conversion to energy needs to be developed with the help of private investors. A common theme worldwide is that all household waste should be sorted and collection of hazardous waste must be prioritized. Smart Technologies can advance green city management: smart technologies can improve waste flows and contribute to the implementation of integrated waste management practices.[32]

STATE OF THE ART IN SOLID WASTE MANAGEMENT IN LATIN AMERICA AND THE CARIBBEAN

Municipal solid waste management achieves an average collection rate or 89.9% (as a percentage of the population). Compared with a worldwide average of 73.6%v, LAC has a high level of coverage, reflecting the priority the region gives to this service. LAC's coverage is higher than that of other regions [Africa (46%), South Asia (65%), and the Middle East and Northern Africa (approximately 85%)]. Argentina, Chile, Colombia, Dominican Republic, Trinidad & Tobago, Uruguay and Venezuela have MSW collection rates close to 100% (universal coverage). [33] Waste management, as practiced in Europe is considered an important guidance.[34] The European Union's approach to waste management is based on the "waste hierarchy" which sets the following priority order when shaping waste policy and managing waste at the operational level: prevention, (preparing for) reuse, recycling, recovery and, as the least preferred option, disposal. The following priority objectives for waste management are in place:

- To reduce the amount of waste generated;
- To maximise recycling and re-use;
- To limit incineration to non-recyclable materials;
- To phase out landfilling to non-recyclable and non-recoverable waste;
- To ensure full implementation of the waste policy targets.[35, 36, 37]

With rapid urbanization and urban residents accounting for between 70-80%, the LAC region is experiencing rapid increase in solid waste generation and growing pressure for solid waste management in cities. The regional average per capita generation of Domestic Solid Waste (DSW), and Municipal Solid Waste (MSW) is 0.6 kg/cap/day and 0.9 kg/cap/day, respectively. DSW represents, on average, 67% of the MSW generated in the region. [38] LAC cities have been exploring alternative approaches for solid waste management, including waste separation and recycling. However, the challenges to waste separation in LAC cities include a lack of:

32. Inter-American Development Bank. 2016. Solid Waste Management in the Caribbean. Proceedings from the Caribbean Solid Waste Conference. file:///C:/Users/Admin/Downloads/Solid-Waste-Management-in-the-Caribbean-Proceedings-from-the-Caribbean-Solid-Waste-Conference%20(1).pdf
33. Inter-American Development Bank. 2015. Solid Waste Management in Latin America and the Caribbean. https://publications.iadb.org/en/publication/17014/solid-waste-management-latin-america-and-caribbean
34. The EU Directive 2008/98/EC sets the basic concepts and definitions related to waste management, such as definitions of waste, recycling, recovery for the EU Members States. It explains when waste is considered to be waste and when it becomes a secondary raw material, and how to distinguish between waste and by-products. http://ec.europa.eu/environment/waste/framework/
35. 7th Environment Action Programme, http://ec.europa.eu/environment/action-programme/
36. Resource Efficiency Roadmap, http://ec.europa.eu/environment/resource_efficiency/
37. Raw Materials Initiative, http://ec.europa.eu/enterprise/policies/raw-materials/index_en.htm
38. Inter-American Development Bank.2015. Solid Waste Management in Latin America and the Caribbean https://publications.iadb.org/en/publication/17014/solid-waste-management-latin-america-and-caribbean

- adequate facilities for distinct between transport, sorting and recycling;
- effective regulatory and policy instruments including financial incentive tools for waste minimization and recycling, and
- public awareness and participation in waste separation at source.

INNOVATION IN THE FIELD OF SOLID WASTE MANAGEMENT IN LATIN AMERICAN AND CARIBBEAN REGION

Like in other part of the world, in the LAC region solid waste management is a bit of a step child of city management. While most entities recognise that waste is an opportunity for resource recovery, and income generation, the substantial potentials of waste-to-energy are not utilized. As many cities do not have pro-active waste management plans, they are not able (or willing) to invest in costly waste-to-energy technologies. Some cities in the region have started with small initiatives to reduce the circulation of single-use plastic products (bags, drinking cups, etc.), but the culture of recycling and reuse is not yet established. Waste management companies have entered the waste mining business, and work with a network of many small collectors; but these are still rather small beginnings. The projections for existing (sanitary) landfills are largely grim what concerns their future capacity or possibility of expansion. But very few cities have created waste-to-energy (WTE) facilities, with Mexico City being an exception. [39] Too many opportunities are left unattended, despite the substantial revenues which the waste management can offer.

EXAMPLES SHOWCASED

The examples selected to showcase good practices in solid waste management are (i) The urban waste recycling programme of Rauch – Buenos Aires, Argentina; (ii) exchanging waste for food in Curitiba, Brazil; (iii) Santiago Recicla: Waste Recycling in Santiago, Chile; (iv) Colombia's business commitment to waste recycling; and (v) the domestic waste recycling programme in Alta Selva Alegre-Arequipa, Peru.

COUNTRY	TITLE	LINK
Argentina	The urban waste recycling programme of Rauch - Buenos Aires, Argentina	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Rauch_-_Unidad_de_Reciclado_de_Residuos__URRA__.pdf
Brasil	Exchanging Waste for Food in Curitiba, Brazil	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Curitiba_-_Programa_Cambio_Verde.pdf
Chile	Santiago Recicla: Waste Recycling in Santiago, Chile	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_18_comunas_-_Santiago_REcicla.pdf
Colombia	Colombia's business commitment to waste recycling	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_10_comunas_-_Asociaci%C3%B3n_CEMPRE_Colombia_-_Compromiso_Empresarial_para_el_Reciclaje.pdf
Peru	Domestic waste recycling programme in Alta Selva Alegre-Arequipa, Peru	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Alto_Selva_Alegre_-_Segregaci%C3%B3n_En_La_Fuente_Y_Recolecci%C3%B3n_Selectiva_De_Residuos.pdf

39. A new Waste-to-energy facility in Mexico City will be one of the world's largest. http://www.smartcitiesdive.com/news/a-new-waste-to-energy-facility-in-mexico-city-will-be-one-of-the-worlds-la/443685/

THE URBAN WASTE RECYCLING PROGRAMME OF RAUCH - BUENOS AIRES, ARGENTINA

The small municipality of Rauch in the province of Buenos Aires has managed to solve its solid waste problems through recovery and recycling of 100% of its waste.

Since 1995 the city of Rauch has adopted recycling, and its Solid Waste Recycling Unit (Unidad de Reciclado de Residuos Rauch [URRA!]) has been able to expand this approach to achieve 100% coverage. The success is due to environmental education and the full participation of the community.

Prior to the start of the recycling programme, the city undertook a detailed review of the waste situation. Rauch, like other cities in Argentina, did have open dumping grounds which caused many environmental impacts. Other cities had not been successful with waste separation and recycling. The review of the waste situation, and the approach to waste classification provided concrete data about the waste characteristics, and the behaviour of the population. The initiative started with education and the waste separation plant.
In 1998, a waste separation plant (´Programa de Procesos´) was established. Initially it separated 25% of the waste collected , and gradually its coverage increased to 100%.

Waste Separation Plant (URRA!)

Compacted Waste Materials

Source: Dirección de Ambiente de la Municipalidad de Rauch

The waste is separated according to classification. Organic, and non-organic (dry or patogenic) materials, papers and cardboards. Non-recycable materials are incinerated.

The waste separation concept at source, in the homes of the families of Rauch, has some 20 years of experience today. This separation is an essential help for the later work at the waste separation plant. The different waste types, organic or dry materials are being collected on different days. On an average day, some 11 tons of waste materials are being collected and processed. The organic matter is converted into compost for agriculture and gardening purposes, while the non-organic materials are separated and prepared for sale. The proceeds from this sale are part of the income of the URRA!

The environmental education which is accompanying URRA!´s work is done through formal and informal channels, through schools or directly with the community. As part of the education, the students and community members visit the waste separation plant. The educational approach pursues waste separation also in the schools, for educational purposes and as its contribution to the URRA process. The citizens of Rauch also celebrate the World Environment Day, and a youth commission for the environment has been created which looks at critical environmental hotspots, like informal waste dumping, and is preparing communication campaigns for community members.

The Project initiative was co-funded with 75% through the World Bank supported Programme for Municipal Strengthening and Deevlopment (Programa de Fortalecimiento y Desarrollo Municipal [PFM]) and the Ministry of the Economy. The remaining funds originated from municipal revenues. The future challenge for URRA! will be to become fully sustainable and expand its capacities to cope with urban growth and developments the waste sector, while maintaining the community outreach and educational activities.

EXCHANGING WASTE FOR FOOD IN CURITIBA, BRAZIL

This project was stimulated by a ´bumper harvest´ of garden and agricultural products in the Curitiba metropolitan region in June 1991. The excess of products lead to serious problems in sale and marketing, just at a time of switching to organic cultivation. Given this complication, programme for green change was created.

The Paraná Federation of Rural Producers (Federação Paranaense das Associações dos Produtores Rurais [FEPAR]), acquired the excess production and organized distribution to families which participated in the waste collection programme of the municipality. Prior to distribution of these agricultural and horticultural products are brought to the points of exchange.

The programme for green exchange works directly with Curitiba´s communities, and has 102 exchange points where community members can exchange 4 kg of recyclable waste into 1 kg of food, or 2 liters of used kitchen oil into 1 kg of food. To manage the exchange, the exchange points consist of two sections: the reception area of recyclable waste products, and the handover point for food items. The exchange points operate Tuesdays to Fridays.

Programme for Green Exchange
Foto: Ascom Prefeitura de Curitiba

Recyclable Waste Products Submitted
Sourc: https://www.gazetadopovo.com.br/vida-e-cidadania/curitiba-venceria-com-inclusao-de-catadores-bng33ilkrhhqvsfexq7e1u2xa/

The social objectives are twofold: increased food security for low-income families, and environmental education regarding waste collection and recycling. The concept of not wasting food products and using these to combat hunger and improve quality of food available to poor families is an innovative approach. The funding for this programme is provided by the Municipal Secretariat of the Environment of the Municipality of Curitiba. The secretariat interacts with the Association of agricultural producers to define terms and tariffs for purchase of their products. By 2017, the 101 exchange pints were able to attend to 6.000 families/month. The amount of food items distributed is 81 tons, while some 4,000 tons of recyclable waste products, and 3,000 liters of used kitchen oils were exchanged.

The impact of the programme is that throughout the city of Curitiba one can observe a high degree of cleanliness to which this recycling programme has contributed. The challenge for the programme will be to incorporate it into the regular operations of the municipality, under the slogan of "Waste is not wasted".

SANTIAGO RECICLA: WASTE RECYCLING IN SANTIAGO, CHILE

This recycling programme benefits 18 districts (comunas) in the metropolitan region of Santiago: Calera de Tango, Cerrillos, Colina, Estación Central, Independencia, Isla de Maipo, La Granja, La Reina, Maipú, Melipilla, Pedro Aguirre Cerda, Peñalolén, Puente Alto, Recoleta, Quilicura, Quinta Normal, San Ramón and Santiago which represent 47.5% of the region´s population. Santiago Recicla is Chile´s most ambitious programme in this field. It is being funded by the Fund for Regional Development (Fondo de Desarrollo Regional [FNDR]), that was approved by regional government of Santiago in 2016. Santiago Recicla originates from the strategy for waste management of the environmental agency of the metropolitan region. This strategy aims at prevention, reduction, reuse, and the eventual recycling of waste, or its final or partial valorization of un-recycled materials as energy products.

Santiago recicla consists of the following main initiatives:

1. Capacity building: a programme of education for students, teachers, neighbourhood groups, municipal staff, and civil society in general.
2. Diagnostic study of the management of solid waste in households, and a publicity campaign for sensibilization with the aim to increase recycling.
3. Infrastructure investments to cover 24 new clean interim waste storage points on public or municipal land within the 18 districts. These installations vary in size between 240 m2, 400 m2 and 1.000 m2 and are meant to receive selected pre-sorted recyclable wastes.

Santiago Recicla - Clean Waste Storage Point
Source: www.amchamchile.cl

The best waste is the one which is not happening. Let´s boost the circular economy
Source: www.santiagorecicla.cl

The objective of Santiago Recicla is to increase recycling activities, and to reduce the amount of waste products which end up in (sanitary) landfills of the Santiago metro region. The project fills a gap through the provision of waste deposits which can receive recyclable materials.

The investment for the 20 new clean waste interim deposits has cost some $2.787.066 millions while the Barrio mprovement Programme has spent another $256.815.850 for four deposits. The project can be seen as complementary to other neighbourhood improvement programmes.

The overall challenge will be to reduce the need for waste to be brought to sanitary landfills or waste dumps. The intention is to reduce household waste by 30% within the next 5 years. The population´s modified attitude and mindset in support of waste recycling.

COLOMBIA'S BUSINESS COMMITMENT TO WASTE RECYCLING

The Recycling organization CEMPRE has established its presence in the cities of Cali, Bogotá, Cartagena, Pasto, Cajicá, Sogamoso, Tocancipá, Zipaquirá, Valledupar, and Medellín. The Asociación CEMPRE Colombia is a corporate social responsibility programme dedicated to waste recycling – their project is called Enterprise Commitment to Recycling. CEMPRE has been established first in Cali where several of its founding members like the Coca Cola Company, Bavaria brewery, and Carvajal packaging firm are located. CEMPRE-Colombia has been established as a not-for-profit organization representing important private sector companies like Alpina, Bavaria, Colanta, Aceros Diaco, Coca Cola, Tetra Pak, Fundación Santa Fe de Bogotá and Unilever. CEMPRE promotes good practices in waste management, with particular emphasis to recycling, and economic sustainability.

Training Sessions for Recyclers
Source: https://cempre.org.co/cempre/cempre-capacita-a-las-organizaciones-de-recicladores-con-el-apoyo-de-la-anr/proyectos

The objective of CEMPRE is to introduce and manage waste recycling in the cities where it is active. It initiates its operations with training and sensibilization of recycling personnel. At the starting point, it presents to the resident communities and the recycling personnel the concept of an integrated recycling approach. The following project achievements are reported:

- Recycling has value: a project implemented in Bogotá and Medellin, specifically oriented at Carrefour (and later the Jumbo supermarkets). The project was implemented during 2010-2012, and achieved recycling of 291.545 tons of waste materials which did not end up in landfills. Under the project, it involved 4 recycling organisations and created additional employment in its offices.

- Cali Recicla Project: this initiative in the city of Cali was implemented during 2012-2014 by Bavaria, Carvajal Empaques, Coca Cola – Femsa and Grupo Familia, in Alliance with the newspaper ´ Diario de Occidente¨and the Cavajal Foundation. The project promoted waste separation at the source. With this initiative it was intended to strengthen the waste separation culture among citizens, and to increase volumes recyclable materials. The organized waste recyclers were supported with means of transport, and regular collection routes were encouraged. This resuklted in a increase of 11% of recyclable materials for Cali´s Waste Recyclers Association.

- Reciclatón Project: The Reciclatón was an itinerant activity which tried to stimulate citizens to submit waste materials like paper, plastics, metals and glass to teams of collectors. The initiative was implemented in the district of Antonio Nariño, Chapinero and

Usaquén in Bogotá; and in the municipalities of Cajicá and Valledupar. The project succeeded in collecting 8.889 kg of potentially recyclable materials. Paper accounted for 54%, plastics with 16%, metals with 15%, glass with 6%, and 10% for others materials.

- Máquinas Pay Back Project: This project implemented in Supermarkets in Bogotá and in offices of Unilever installed collection points (´Ecopuntos´) to collect empty bottles and pay for these. Through this initiative some 220.000 bottles or 9.826 tons of recyclable waste were collected. 5.365 consumers participated.

- Handbook for the formulation and implementation of solid waste projects and planning for integrated waste management plans was written in 2015, in collaboration with the Ministry of Housing, The Inter-American Development Bank (IDB) and other multilateral development organisations. The handbook coincided with the Ministry´s resolution 754 of 2014 which obliges municipalities to manage waste in a more integrated manner.

- Census of recycling activities in Cartagena: This census was done in support of the municipal administration´s obligation to review and register all recycling activities. The survey results showed that 76,4% of the recyclers are not organized and receiving any support.

CEMPRE´s activities are self-sustaining. In 2017, its income was about $151.980 while its operation costs amounted to $117.705. This result is very remarkable and unscores again, that there is money in waste, even if handled as a not-for-profit operation. CEMPRE´s success is associated with the fact it has always stressed the importance of empowerment of its staff and collaborators, seeking recognition and dignity for their kind of work for the benefit of the environment.

DOMESTIC WASTE RECYCLING PROGRAMME IN ALTA SELVA ALEGRE-AREQUIPA, PERU

The Alto Selva Alegre district of Arequipa is home to an innovative domestic waste recycling programme. In 2016, the waste generated in the district amounted to 0.52 kg/hab/day. The total waste generated by the district are 43 tons/day.

Since waste generation has been increasing, the District has initiated in 2011 its programme for waste separation at the source. The programme was sponsored by the >Ministry of Economy and Finance and embedded in the municipal modernization initiative of 2010-2013. Since then the programme continues as a municipal activity under the Subdivision of Public Cleanliness and Environmental Management.

Municipal Recyclers at a training event.
Fuente: Municipalidad de Alto Selva Alegre

The Ministry of Environment encourged waste separation and recycling with the overall objective to improve claenliness and reduce environmental contamination. The programme started with sensibilization of residents of the district, and provided maps of waste collection services, and informed about the services of the informal waste collectors. These (informal) waste collectors and recyclers were given vehicles and they were requested to establish time tables and regular frequencies of collection.

To strengthen the economic perspective of these waste collectors, they were trained and oriented to improve their services to the city. Equally, the citizens and some 22 educational institutions were trained and oriented about their role in waste and environmental management. The districts inhabitants formed neighbourhood committees to supervise environmental issues and to inform about non-compliance of desired standards. As part of the campaign, environmental murals were painted.

FLOWCHART OF THE RECYCLING PROCESS IN ALTO SELVA ALEGRE

First Stage:
Generation at the source of recyclable solid waste

Second Stage:
Picking up the waste

Third Stage:
Recyclable solid waste collection

Fourth Stage:
Segregationof recyclable solid waste

Fifth Stage:
Program identification

Sixth stage:
Final sale

The results of the programme are manifest in the progressive increase of households participating in the initiative. By 2017, some 9,566 households have participated. The waste recyclers have been able to collect 164,550 kg of waste, and have been able to generate income for the three associations involved. A total of s/. 81,856.27 soles (=$24,804) annually

The effectively separate waste that was collected increased from 21.82% in 2011 to 41.75% in 2017. La participación del 100% de la población de Alto Selva Alegre en el programa de Segregación en la Fuente y Recolección Selectiva de Residuos Sólidos Municipales.

Annual municipal expenses for the programme have been about $30.000.

The most notable challenges are to achieve the participation of 100% of the households, and deal physically with the rapidly growing amounts of recyclable materials. More recyclable materials means more transport needs and more operational costs. The model of a neighbourhood-based environmental and waste management is unique for Peru, and certainly an example for other cities and other countries.

CHAPTER 8

ENVIRONMENTAL MANAGEMENT

"Habitat III concluded with the drafting of a New Urban Agenda, highlighted by the Quito Declaration on Sustainable Cities and Human Settlements for All. This is a landmark document in Urban Environmental Management by pledging in Section 14. (c) to be guided, among others, by the principle: "Environmental sustainability, by promoting clean energy, sustainable use of land and resources in urban development as well as protecting ecosystems and biodiversity, including adopting healthy lifestyles in harmony with nature; promoting sustainable consumption and production patterns; building urban resilience; reducing disaster risks; and mitigating and adapting to climate change ". A further statement of note is that a fundamental driver of change is: "….reinvigorating long-term and integrated urban and territorial planning and design in order to optimize the spatial dimension of the urban form and to deliver the positive outcomes of urbanization." [40]

In Latin America … the most important of these urban environmental problems were grouped by three different themes: [41]

- Brown agenda: water supply; sanitation and drainage; solid waste; emissions from cars, trucks, buses and low-grade domestic fuels; congestion and crowding; noise.
- Grey agenda: pollution of the air, soil and water, including that of hazardous waste, as well as factory and fossil-fueled power plant emissions. Reduction of green-house-gas emissions is part of this grey agenda, although there are also overlaps with the brown agenda in the case of the water and waste sectors.
- Green agenda: natural resources, as well as flora and fauna, and the human occupation of lands with a sensitive green environment. "A central concept that was stressed was that each urban conglomerate should not forget the ties to its rural area and to the eco-region where it is located by trying to reduce its ecological footprint. At this point, the conservation of urban reserves, national parks, or botanical gardens plays a decisive role in the sustainable debate because they are living resources that can promulgate a strong message about the links between urban health and the health of the region." [42]

Since topics of the conventional brown agenda (water, sanitation, waste management) are dealt with in two separate chapters, and since the green agenda is less pronounced in cities, this chapter is mostly concerned with the grey agenda.

WATER POLLUTION

"Experts are warning of a possible public health and environmental crisis after it was revealed that rivers in Latin America are some of the most polluted in the world. … over 70 per cent of water used in the region returns to rivers with no treatment. This means that sewage and industrial waste are put back into rivers and other sources of water such as lakes and dams. The issue of water pollution is of particular concern in Latin America, as around 80 per cent of the population live in urban areas which are often close to contaminated rivers." [43] Latin Americans are not necessarily affected by water scarcity, but by a clean water scarcity…the average person only has access to just over 300 cubic metres.[44]

AIR POLLUTION

Again, UN-Habitat reports that "[a]ir quality in large agglomerations is also a cause for concern. Many cities suffer from air-borne particulates such as pollen, ash, mineral dust, cement and metals. Experts call these 'PM10' because they measure up to 10 micrometres. These have adverse health impacts and scientists have

40. Edelman, Schuster, Said. 2017. Urban Environmental Management in Latin America, 1970-2017. https://www.scirp.org/journal/PaperInformation.aspx?PaperID=78610
41. Vásconez, S. D. (2000). Hacia una nueva gestión ambiental urbana. In C. Fernando (Ed.), Desarrollo Cultural y Gestión en Centros Históricos (pp. 247-256). Quito: FLACSO. https://biblio.flacsoandes.edu.ec/catalog/resGet.php?resId=43640
42. https://www.thenatureofcities.com/2015/10/19/urban-latin-america-hows-it-going/
43. https://www.globalpolicy.org/social-and-economic-policy/global-public-goods-1-101/46052-the-struggle-for-latin-americas-water.html
44. https://www.theguardian.com/global-development-professionals-network/2016/mar/17/live-qa-what-are-the-steps-to-ending-water-pollution-in-latin-america

linked high concentrations of PM10 with cardiovascular and respiratory diseases, as well as with increased morbidity and mortality. [45]

SOIL POLLUTION

Uncontrolled industrial activities and mining towns are particularly contributing to soil, air and water pollution.[46] "Peru … ranks among the world's top five producers of silver, zinc, lead and copper and has a long and conflict-ridden mining history. Exposure to lead in this country may have been prolonged, despite some widely publicized and severe cases, by the importance of the revenue generated by the mining industry, weak regulation, a lack of information about contamination and a perception that the cost of interventions might be prohibitive." [47]

OUTLOOK AND FUTURE SECTOR AGENDA

Despite the movement to recognise the problems of the environment, to assessing the effects of pollution on the largely urban population, to recognising the systematic nature of the interconnections of the environment and the region's urban based economy and hence the need for sustainable development, to attempting to create the framework, policies and tools to manage the urban environment, it is clear that the problems of the past have not yet been solved.

Existing institutional and legislative framework do not sufficiently enable both community and municipal actors to deal with pollution and protection of the urban environment. Many LAC region governments have well drafted environmental legislation (like the case of Bolivia and Colombia illustrate), but implementation of these does not come automatically with the passing of these legislative norms. By 2002, many countries already had the laws, the institutions and even some judicial victories to support Urban Environmental Management, but serious issues of pollution remained due to systems of production and consumption that were not updated at the necessary pace. [48] "Thus, the time for policy development is over; it is time to act."[49]

INNOVATION IN THE FIELD OF ENVIRONMENTAL MANAGEMENT IN LATIN AMERICAN AND CARIBBEAN REGION

Certainly, there are many proposals how to stop water pollution in the Americas. An expert panel has made 10 suggestions, the foremost being "Stop Polluting". [50] Numerous non-governmental, community and private sector actors are engaged in pollution abatement and attempts to turn back the tide. Results are quite mixed, but unfortunately, in many countries environmental championship is not appreciated, and many social and environmental leaders have paid for their engagement with their lives.

45. UN-Habitat. 2012. State of Latin American and Caribbean Cities Report 2012. p.113-114. https://citiesalliance.org/resources/knowledge/knowledge-resources/state-latin-american-and-caribbean-cities-report
46. https://revista.drclas.harvard.edu/book/environmental-agenda-latin-america
47. https://www.who.int/bulletin/volumes/90/12/12-106419/en/
48. Rodríguez-Becerra, Manuel y Guillermo Espinoza. Gestión ambiental en América Latina y el Caribe: Evolución, tendencias y principales prácticas. Banco Interamericano de Desarrollo: Washington, DC, 2002. http://cebem.org/cmsfiles/publicaciones/gestionambientalLACaribe.pdf
49. Edelman, Schuster, Said. 2017. Urban Environmental Management in Latin America, 1970-2017. https://www.scirp.org/journal/PaperInformation.aspx?PaperID=78610
50. https://www.theguardian.com/global-development-professionals-network/2016/apr/12/ten-ways-prevent-water-pollution-latin-america

EXAMPLES SHOWCASED

The examples are: (i) the green-house-gas emission inventories in Buenos Aires, Argentina, as part of action planning for measures against climate change; (ii) the participatory green community development project in Manaus, Brazil; (iii) Chile's Plan for Prevention and Decontamination of the Atmosphere; (iv) community guards against settlements on dangerous slopes in Manizales, Colombia; and (iv) the community-based early warning system on the hills of Lurigancho-Chosica, in Lima, Peru against landslides and flood events.

COUNTRY	TITLE	LINK
Argentina	Green-house-gas emission inventories in Buenos Aires, Argentina	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Ciudad_de_Buenos_Aires_-_Inventarios_de_GEI_en_el_marco_del_Plan_de_Acci%C3%B3n_de_Cambio_Clim%C3%A1tico_2020.pdf
Brasil	Participatory green community development project in Manaus, Brazil	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Manaus_-_Proyecto_Verde_en_las_Comunidades.pdf
Chile	Chile's Plan for Prevention and Decontamination of the Atmosphere	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Chile_-_Plan_de_Prevenci%C3%B3n_y_Descontaminaci%C3%B3n_Atmosf%C3%A9rica__PPDA_.pdf
Colombia	Community guards against settlements on dangerous slopes in Manizales, Colombia	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Manizales_-_Guardianes_de_la_ladera.pdf
Peru	Community-based early warning system on the hills of Lurigancho-Chosica, in Lima, Peru	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Lima_-_Creaci%C3%B3n_de_un_Sistema_de_Alerta_Temprana_integral.pdf

GREEN-HOUSE-GAS EMISSION INVENTORIES IN BUENOS AIRES, ARGENTINA

The city of Buenos Aires, through its Environmental Protection Agency (Agencia de Protección Ambiental [APrA]), undertakes an annual monitoring of its green-house-gas (GHG) emissions. This monitoring of air quality has begun in 2000. The continuity of the exercise permits to identify the principal factors contributing to air quality changes, and it allows to suggest measures of mitigation.

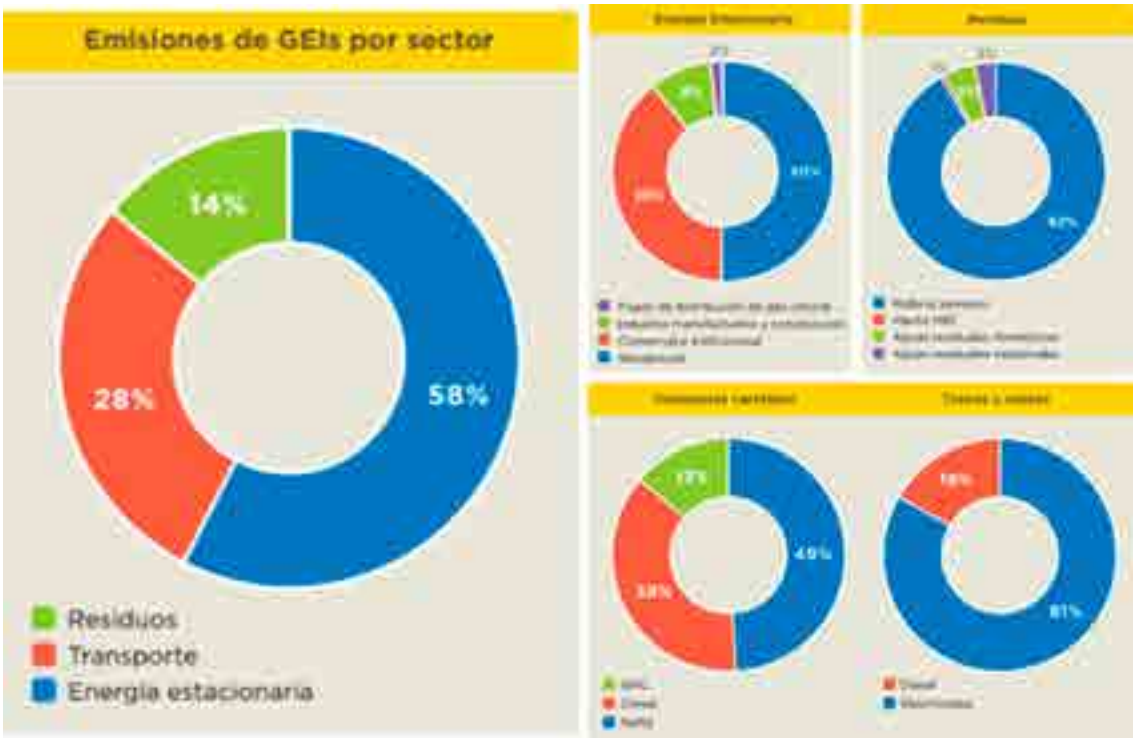
Buenos Aires is participating in national and international activities which are directed at the battle against climate change and its impacts. Since 2008, the city attempts through GHG inventories as diagnostic instruments to monitor progress of mitigation measures. Since recently (2016) it has a climate action plan. The first inventory was published in 2009 as part of the city´s Climate Action Plan 2010-2030. The inventory presents GHG emissions from different sources and locations, based on the 2000-2008 data.

For the emission estimates a software called H.E.A.T. was used which the International Council for Local Environmental Initiatives (ICLEI) provided. This software used as reference the data base of the Intergovernmental Panel of Climate Change (IPCC) and those of the (later) Global Protocol of Green-House-Gas Inventories at Community Level (GPC). In 2010, APrA and Buenos Aires joined international efforts to work on the systematization of inventories, and joined the Compact of Mayors promoted by C40 – Bloomberg Philantropics. Hence, the city has updated its inventories based on the data collected since year 2000.

Though still basic – as per the categorisation of the GPC – these inventories include emissions by the public sector and by the community as a total. The inventory covers data on energy consumption, transport, and solid waste. The adoption of GPC standards has offered a clear and robust framework, based on existing and internationally recognized methodologies which calculate and report GHG emissions with more trustworthy and relevant results.

Climate Action Plans of Buenos Aires – 2009 and 2016-2020
Source: Gobierno de la Ciudad de Bs. As. "Cambio Climático, Plan de Acción Buenos Aires 2020" y "Plan de Acción frente al Cambio Climático."

Thus, the inventory has become the main basis for the Action Plan against Climate Change 2020 (Plan de Acción frente al Cambio Climático [PACC])[51] . Within the city´s para a team of specialists support and supervise the process of regular updating of the inventory, and the work with the international agencies, mainly ICLEI y C40. The regular updating of the inventory is a permanent challenge since access to reliable information is always difficult, like also the cross-referencing of data obtained. Funding for the inventory has been from own municipal funds.



Main results of Green House Gas Inventory - Buenos Aires 2014. Total Emissions: 12.928.646 tCO2eq.
Source: recopilación propia de imágenes del Plan de Acción frente al Cambio Climático 2020.

The challenge for the future will be to broaden data catchment and to expand the inventory to reach the basic level (Basic+) proposed by GPC. This should be more than the BAU ('business as usual') Scenario, with projections towards 2030.

51. Gobierno de la Ciudad de Buenos Aires. "Inventario de Emisiones de Gases de Efecto Invernadero". Recuperado de: http://www.buenosaires.gob.ar/agenciaambiental/cambioclimatico/mitigacion/inventario-de-geis

PARTICIPATORY GREEN COMMUNITY DEVELOPMENT PROJECT IN MANAUS, BRAZIL

Brazil´s national policy for the environment (Law 9.638/81) defines the creation and development of open green areas for collective use in the periphery of cities as space that shall be used for sports, recreation, and environmental education.

In the city of Manaus the citizens are using their green areas for construction of sports grounds, community centers and other infrastructure which are being adopted by the municipality. Different from other protected spaces, green areas do not necessarily represent public obligations for the city. Instead, the concept of ´implementation of public equipment´ suggests these investments shall be discussed with local communities, and they shall be involved in the management of these green areas, using them for social activities, and with the objective to protect the existing vegetation and fauna.

The green open areas in Manaus have suffered from population pressure and informal occupation, and unorganized garbage disposal, and the negative influence of open drug trade. For example, the settlement of Campo Dourado is located in the Cidade Nova neighbourhood, with public open areas which are considered "red" no-go areas which are dangerous and inadequate for social activities due to degeneration of its native vegetation and disappearance of its local wild life. Nevertheless, the inhabitants use parts of the green areas for sports activities, and for football practice, but socially and environmentally these areas are very disorganized.

The green community development project started with a public consultation of beneficiary community, and a presentation of project opportunities with regard to the proposed transformation of the green areas. The project envisaged the planting of flowers and plants, and their maintenance through the participation of the community members. As landscaping elements, the project proposed the installation of open air gyms, children´s playground, volleyball courts, football fields, walking tracks, outdoor illumination and tarmac footpaths, in addition to the gardens and rehabilitation of degenerated areas. To stimulate community participation and identity, the project was to be managed by the community members themselves. Educational activities are designed to promote the recovery of the public outdoor spaces.

Green Community Development in Manaus

Green Community Development

Pictures: Cristhiany Vidal

The results of this project are manyfold, as the physical recuperation of green areas, and the development of the sporting and social facilities shows. The community takes actively part in the management process of the project, and in the decisions about use of the open areas. The community supports the environmental agenda, and gets the benefit of small commercial opportunities in the project area. In order to monitor the project´s environmental agenda and to undertake adjustments, regular community meetings are held.

The project can demonstrate that such participatory projects can instill sustainable environmental protection and better community cohesion. Based on the project´s success, an additional five project areas are being prepared in Parque do Juventude na Área Verde Campo Dourado, Águas Claras I e II, Titio Barbosa e Xingu.

CHILE'S PLAN FOR PREVENTION AND DECONTAMINATION OF THE ATMOSPHERE

Atmospheric contamination remains a challenge for Chile. 10 million of its 18 million inhabitants are exposed to MP 2.5 concentrations above the established maximum norm. Atmospheric contamination is responsible for 4.000 premature deaths annually.

Atmospheric contamination in Santiago, 2016
Source: https://www.emol.com/noticias/Nacional/2016/10/13/826244/Contaminacion-atmosferica-alcanzo-record-de-740-episodios-criticos-en-diez-ciudades-del-pais.html

Santiago´s Air Quality App
Source: http://airesantiago.gob.cl

The government´s Plan for Prevention and Decontamination of the Atmosphere (PPDA) is an instrument which considers measures and programmes to reduce the emissions of certain pollutants. The Plan aims to recover good environmental levels as established in the primary and secondary environmental norms.

Santiago´s metropolitan region was declared ´saturated´ with carbon monoxide (CO), suspended articles (PTS), material particles (PM10), fine particles (MP2,5), and ozone (03). The 1990s have been a critical phase for Santiago´s air quality, and the city was obliged to seek alternatives for this situation. In 1997 its Plan for Prevention and Decontamination of the Atmosphere was prepared, followed in 2000 by its Plan for Urban Transport in Santiago (PTUS) which tried to unite efforts for decontamination. Among the most relevant measures of the PPDA was the enhancement of regulations about fuel quality, about industrial emissions, emission controls for fixed and mobile assets, the retirement of highly polluting 2.700 buses without green label, introduction of cars with catalysator, improved pavements of hundreds of kilometers, regulation for emissions from homes, and the gradual upgrading of the Transantiago bus fleet towards electromobility. Due to these actions, the contamination has been reduced during the last decade, leading to lower intensity and duration of critical periods. In 2017, for example, there have been 27 critical periods which is 36% less than in 2016. Despite these achievements, much remains to be done, and the PPDA itself may require updating or stricter measures to succeed. At a national level, sadly, the periods of critically high pollution have increased in the regions of Bio Bio, La Araucanía, Los Ríos, Los Lagos and Aysén. The cities of Coyhaique, Temuco and Valdivia have the highest pollution levels in Chile, due to their continued use of firewood, and lack of rainfall.

The new PPDA will US$ 1.013 m, but will have benefits estimated to reach US$7.977 m. The major pending issues are the removal of open chimneys, the expansion of the underground metro, the electrification of all Transantiago buses, expansion of bicycle use, modernized heating systems, and a wider educational effort in support of decontamination of the atmosphere.

COMMUNITY GUARDS AGAINST SETTLEMENTS ON DANGEROUS SLOPES IN MANIZALES, COLOMBIA

The municipality of Manizales is situated at the slopes of central Andean mountain range (Cordillera) which have a height of 870 to 4.050 meters. Its urban topography is marked by abrupt altitude changes, (informal) settlements built on dangerous slopes. This situation is aggravated by frequent and heavy rainfalls, high seismicity, soft soils due to presence of volcanic ashes. On the other hand the informal settlements have exacerbated the chance of disasters. Manizales has a history of many tragedies associated caused by landslides.

Figura 67: Deslizamientos mortales en asentamientos informales
Source: https://www.semana.com/nacion/articulo/deslizamiento-de-tierra-en-manizales-y-otras-emergencias-en-colombia/522736

Figura 68: Guardias comunitarios en servicio
Source: http://alternativa.com.co/gente/desfigurando-limites-guardianas-de-la-ladera.html

Since 2013, the programme of community guards has been launched. More than 100 women, heads of households between 35 to 60 years of age are contracted by the Municipality of Manizales and the regional environmental agency Corpocaldas in order to implement the works which seek to clean and protect the most dangerous slopes, and to educate the community about the dangers of these slopes and about suitable options for a safer life: The programme shows that risk management can become a source of income for economically vulnerable groups, and it can be a vehicle for empowerment of communities which live with constant disaster risks.

Since 2013 the programme has spent some COP$ 1.764 m (= US$ 750.000) from the budgets of CORPOCALDAS and the municipality. Both, CORPOCALDAS and the municipality, the Red Cross, the electricity company EMAS, the water company Aguas de Manizales, and the environmental research center IDEA of the university support the management of the programme. A survey of settlements with high risk potential ("Inventario Físico y Poblacional de las Viviendas Ubicadas en Zonas de Alto Riesgo") has been conducted.

The use of community guardians has been an essential factor to success. The preferred choice for guardians are mothers who are female household heads who convincingly can interact with the communities and convey the necessary messages. Under the project, the guardians permanently receive technical training and as remuneration they receive half a minimum salary. Since the ,municipality only allows contract periods of 11 months per year there is a continuous contracting effort, and problems of motivation among the guardians exist.

Community Guards protecting a site
Source: (Carmona Mejía, 2018)

Prevention of landslides
Source: (Agencia de Noticias UN, 2010)
http://agenciadenoticias.unal.edu.co/detalle/article/un-en-manizales-en-busca-de-la-proteccion-de-deslizamientos.html

This unique programme has saved many lives, and its innovative concept is an inspiration for many similar support programmes.

COMMUNITY-BASED EARLY WARNING SYSTEM ON THE HILLS OF LURIGANCHO-CHOSICA, IN LIMA, PERU

The city of Lima is located between the western edge of the Andean mountain range and the pacific ocean. It is home to about one third of Peru´s population and concentrates 50% of the countries economy. The district of Lurigancho-Chosica is located in the east of the city, and most of it has been built through informal processes, extending along the Rimac river and into the hills of the mountains. These mountain slopes have been plagues by an increasing frequency of intensive rains which in turn have caused landslides (´huaycos´)[52] and flood events, causing death and destruction of homes, and conditions of habitational risks. As such Lurigancho-Chosica belongs to the group of 461.000 persons who currently live high risk areas in Peru.

The authorities of Chisoca have initiated since 2014 an early warning system ("Sistema de Alerta Temprana" [SAT]) which consists of 4 elements: (i) assessment of risks, (ii) monitoring and alarms, (iii) dissemination and communication of warnings, (iv) capacity to react. Due to lack of efficiency other early warning systems for Huaycos, and the consultancy organization Soluciones Prácticas´ (Practical Action) developed a pilot SAT model in Lurigancho-Chosica. The intention was to develop an integrated, participatory, reliable and cost-efficient system. The development of this SAT was supported by the Project ´Aliados ante Inundaciones¨ (associates against flood events) whose objective is a reduction of vulnerability of poor settlements in the watershed regions of the Rimac and Piura rivers.

Monitoring with Photographic camera, and Community brigadiers
Source: Soluciones Prácticas

52. También conocido como aluvión, alud y/o avalancha, el huayco (palabra de origen quechua) es un desplazamiento de magnitudes ligeras a moderadas de pequeñas o grandes masas de agua con mezcla de suelos, lodo y rocas (Decreto Supremo N 034-2014-PCM, que aprueba el Plan Nacional de Gestión del Riesgo de Desastres-PLANAGERD 2014-2021. Lima, Perú, 12 de mayo de 2014).

Monitoring with Photographic camera, and Community brigadiers
Source: Soluciones Prácticas

The Project was developed through action research methodology. It was very low-cost. The 4 elements of the work included:

1. Assessment of risks: this included risk mapping and the installation of 60 flow meters to measure increase in water volumes.
2. Monitoring and alarms: This included the installation of four monitoring stations on roof tops of existing houses.
3. Dissemination and communication of warnings: This entailed the creation of a WhatApp chain of communication towards community leaders, who themselves will inform their community members.
4. Capacity to react: Through community brigadiers who were trained in emergency measures, preventive action and first aid.

The Project was supported with £15.000 donated by Zurich Foundation. Achievements of the project are Notable. During the last major emergency of March 2017 the population in Lurigancho-Chosica was evacuated days before the arrival of the huaycos and flooding. The installation of the SAT system has also contributed to reduce tensions between the community and the local authorities; there is less conflict potential. The community has matured and training was provided through the network of community brigadiers. The spirit of disaster preparedness spread and manifested itself in the creation of the network of resilient community leaders (Red de Líderes Resilientes along the Rímac rivers and its branches [in districts of Chosica, Chaclacayo and Ate]) who are prepared for future disasters.

The local knowledge of brigadiers and community members has proven very useful as they know the local conditions well, and can help to guide risk assessment and preventive measures.

CHAPTER 9

GREEN INDUSTRIES AND THE **CIRCULAR ECONOMY**

Many LAC countries are conceptually supporting the circular economy. This includes co-generation of energy for industrial or non-industrial purposes, and the recycling and reuse of all resources required for industrial production. A growing number of industries have come into existence to demonstrate the viability of the concept of clean industrial production. A serious pursuit of the green industries´ concept is urgent as part of the national campaign for cleaner air.

'It is well documented that 75% of natural resource consumption occurs in cities. Cities produce 50% of global waste and 60-80% of greenhouse gas emissions. These are symptoms of the 'take, make, dispose' linear economic model. The need for change is increasingly evident, with cities feeling the effects. The circular economy offers an opportunity to respond to these challenges by rethinking how we use materials, leading to wholly new ways of creating value. Cities are where most materials are used and wasted, and where buildings, cars, and products are consistently under-used.' [53] Industrial symbiosis offers the same kind of solution, whereby the waste or by-product of one enterprise becomes the resource or input of another. Green industrial complexes and eco-industrial parks have defined ambitious targets for reducing energy consumption, waste generation and carbon emissions. [54]

CLEAN ENERGY

Cities with effective recycling schemes can recycle up to 75% of household waste, but manufacturing and construction activities generate four times as much waste as households. One way to overcome this problem is to mimic nature, where waste produced by one organism often is reabsorbed by another. Industrial processes can follow a similar path, turning the waste or by–product of one enterprise into the resource or input of another. This is commonly known as waste-to-energy (WTE). The objective of the WTE-approach is to achieve the decoupling of economic growth from natural resource depletion and environmental degradation. Successful implementation requires government involvement and effective institutional arrangements. Although introducing the WTE-approach initially imposes some increased costs and often requires substantial investments from both government and private entities, many of the WTE solutions also turn out to be economically advantageous when the costs of environmental externalities that are avoided are fully taken into account. The legislation, policies, and pilot programs already in place demonstrate the potential of WTE.

CITIES AND HIGH CARBON EMISSIONS OF CARBON-BASED FUELS

Cities in the LAC region are large procurers of materials, energy and infrastructure. The cost of materials for building construction is an increasing concern, as construction activities are taking place at a high pace and little experience exists in recycling of building materials. The energy demand for cement and metals production is enormous and the rapid developing housing sector thus has a direct impact on energy demand and emissions. Improving energy efficiency in the construction sector, especially in the production of building materials and recycling of materials, will have a significant positive impact on the environment. LAC commitment to increase the share of non-fossil fuels in primary energy consumption is strong and has been confirmed through several important agreements. The principal commitment is to increase non-fossil fuels to around 20% by 2030. One of the measures is promotion of trade in green goods through e.g. encouraging trade in sustainable environmental goods and clean energy technologies; focus on smart low-carbon cities and smart low-carbon growth technologies.

53. Ellen Macarthur Foundation. 2019. Circular Economy in Cities.
https://www.ellenmacarthurfoundation.org/assets/downloads/Circular-economy-in-cities-preview-paper.pdf
54. World Bank. 2014. Building Competitive Green Industries: The Climate and Clean Technology Opportunity for Developing Countries. Washington. D.C.
file:///C:/Users/Admin/Downloads/911600WP0P130900Box385328B00PUBLIC0.pdf

OUTLOOK AND FUTURE SECTOR AGENDA

'Latin America is known for its abundance in natural resources, accounting for 44% of world's copper, 49% of silver, 65% of lithium, 20% of world's oil reserves, 33% of freshwater reserves and 20% of native forests on the Earth. However, during the 20th century, the region was not able to translate its wealth into long-term economic development, mainly due to its lack of comprehensive resource and waste management policies, as well as having an early-stage entrepreneurial and innovation activity during that period of time.

According to the World Bank, Latin America generates 160 million tons of solid waste per year -with an average per capita value of 1.1 kg/day- but less than 3% gets reused or recycled. However, it is expected that by 2030, the region will increase its population by 17%, reaching 705 million, further incrementing its per capita waste generation by up to 45%, reaching 1.6 kg per day. Furthermore, in Latin America over 60% of the waste ends up in inadequately controlled landfills. Solid waste composition has also changed from being mostly organic to become mostly non-biodegradable. In fact, the region currently produces 9% of the world's total e-waste, and it is expected to increase to 15% by 2018.

Eventhough Latin America only accounts for 8% of the world's GDP it has successfully managed to take 70 million people out of poverty while expanding its middle class by 50%, showing one of the world's highest urbanization rates, reaching a 75%, compared to a world average of 50%. However, due to the current economic slowdown, the region has experienced low growth averages of 2-2.5% and unemployment is expected to rise to 6.9% on 2016, meaning that approximately 19 million people won't be able to find a job. As shown above, Latin America has a unique potential in terms of the efficient use of its resources and the creation of new waste management policies that can generate interesting opportunities for the new entrepreneurial and innovative culture that has developed in the region for the last decade. Under the current economic, social and environmental scenario, moving towards a circular economy can become a key industrial policy strategy for a job-rich economic recovery in Latin America, providing triple wins for jobs, business and the environment'.. [55]

INNOVATION IN THE FIELD OF GREEN INDUSTRIES AND THE CIRCULAR ECONOMY IN LATIN AMERICAN AND CARIBBEAN REGION

Like in other part of the world, in the LAC region green industries and the circular economy are relatively new concepts. Innovative companies have started to include sustainability criteria in their agendas, and are working towards a more environmentally conscious treatment of natural resources and wastes from their production. Since many of the LAC economies are aspiring or already members of the Organisation for Economic Co-operation and Development (OECD), the concern for green and cleaner production through the circular economy approach is taken more serious. Companies have started to measure their environmental footprint (in accordance with ISO 1440/44) and are reporting their energy-efficiency and their environmental measures, as their commitment with the society. In most countries it has become entrepreneurial pride to be listed among the most 'green', 'clean' and 'competitive' companies. Entire cities, like Medellin in Colombia, are subscribing to the concepts of innovation, green growth and sustainability.

55. https://www.petarostojic.cl/latin-america-and-the-circular-economy/

EXAMPLES SHOWCASED

The examples selected to showcase good practices of green industries and the circular economy are (i) recovery and recycling of used vegetable oil as bio-diesel in Argentina; (ii) cleaner cement production in Brazil; (iii) Neptuno Pumps – an award-winning innovative recycling concept in Iquique, Chile; (iv) Bavaria beer brewery – an example of a Colombian green industry; and (v) recycling of fuel by a logistics company in Peru.

COUNTRY	TITLE	LINK
Argentina	Recovery and recycling of used vegetable oil as bio-diesel in Rosario, Argentina	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Rosario_-_Recuperaci%C3%B3n_de_Aceite_Vegetal_Usado__AVU__con_Producci%C3%B3n_de_Biodiesel.pdf
Brasil	Cleaner cement production in Brazil	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Brasil_-_Votorantim_Cimentos.pdf
Chile	Neptuno Pumps – an award-winning innovative recycling concept in Iquique, Chile	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Iquique_-_CIEC_y_Neptuno_Pumps.pdf
Colombia	Bavaria beer brewery – an example of a Colombian green industry	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_6_ciudades_-_Bavaria.pdf
Peru	Recycling of fuel by a logistics company in Peru	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Lima_-_Uso_De_Aceite_Reciclado_Por_Una_Empresa_De_Log%C3%ADstica.pdf

RECOVERY AND RECYCLING OF USED VEGETABLE OIL AS BIO-DIESEL IN ROSARIO, ARGENTINA

In the city of Rosario, used vegetable oil, both from commercial enterprises and from private homes has been used to create second-generation bio-diesel. This bio-diesel enters the market through its use in public transport vehicles. The city has started to experiment with this recyling product on a pilot basis, to replace traditional fuels.

It is estimated that in Rosario the public transport consumes annually about 25 million liters of gas oil (23 m liters for buses, and 2 m liters for taxis). In Rosario, the annual consumption of edible oils is about 10 million liters whose remains are being drained away in the sewage networks or open drains. The municipality assumed that these used oils could be transformed into bio-diesel. Their recycling would contribute to a reduction in green-house-gases (GHG). In 2008 the Programme for Bio-Transport of Rosario was created.

The first stage of the production of bio-diesel is the collection used oils (Aceites Vegetales Usados [AVU]), from restaurants. Through a municipal ordinance, the recycling of these used oils has become an obligation. Additionally, households are also invited to deposit their used oils in reception centers located in all district municipality buildings. The second stage is the collection and processing of these used oils into bio-diesels. These bio-diesels are mixed with traditional diesel, and thus reduce the overall consumption of diesel.

During a period of eight months in 2014 the performance of these bio-diesels was monitored. In 2018, the use of bio-diesels was rolled out, and 363 buses started to a mixture of 20% bio-diesels mixed with 80% gasoil. On an experimental basis a small number of buses uses 100% bio-diesel.

Public transport buses using bio-diesel
Source: Dirección de Innovación y Calidad Ambiental de la Municipalidad de Rosario

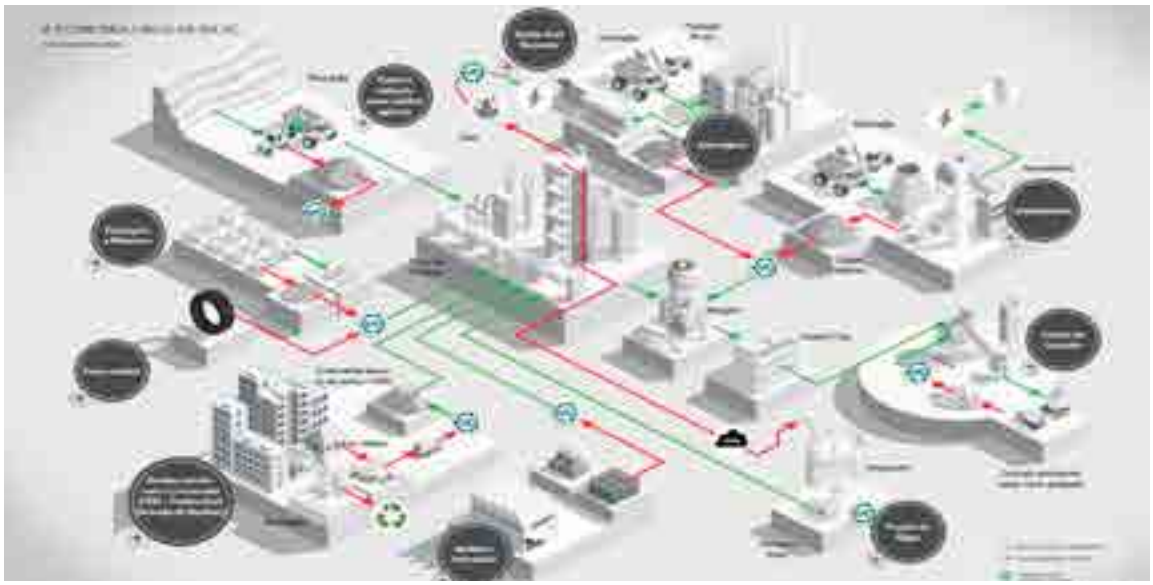
Collection points for used household oils
Source: https://www.rosario.gov.ar/web/ciudad/medio-ambiente/reciclado

The project is part of Rosario´s Environmental Development Plan. The project was designed with wide participation of urban stakeholders: The Municipality of Rosario, Foundation of Energy and Environmental Research (Fundación de Investigaciones Energéticas y Medioambientales [FIEM]), Secretariat of Energy-Province of Santa Fé, the Transport Company of Rosario S.A:, SEMTUR, the Argentine Chamber of Bio-Fuels (CARBIO), the Chamber of Small Enterprises of Bio-Fuels (CEPREB), gastronomic enterprises, transport companies, and the general population.

The project was funded by the municipality of Rosario. Thanks to the project, the city collected in 2017 12.512,5 liters of used oils which otherwise would have contributed to environmental pollution. In future, the city plans to increase the collection of used oils, and to increase the number of public buses which use this type of fuel.

CLEANER CEMENT PRODUCTION IN BRAZIL

The Brazilian cement company Votorantim has gradually been investigating the transformation of its production process, with the intention to make it more sustainable. The idea is to adapt to a low-carbon economy, and to become competitive under new environmental parameters where environmental processes are equally valued like the products themselves. One of the initiatives is directed at the conversion of biomass (like rise husk, wood pellets, African palm residues [´açai´ stone],) which can be used for cement burning. Besides biomass, other industrial waste products and urban household waste are also used. Waste to energy processes are also considered as thermic resource.



The Circular Economy Flowchart of Votorantim | Source: Votorantim

Through the new energy model of Votorantim, the company can save conventional fuels, and contribute to a reduction in waste. Each ton of waste transformed into fuel or energy, avoids the emission of 1.177 kg co2.

In the Votorantim factory units in Mato Grosso, the biomass is mostly composed of wood waste products, agricultural waste, and waste from sugar plantations. A total of 24% of the conventional fuels can be replaced by these environmental practices. The circular economy processes in Votorantim´s Brazil branches have increased by 5% in 2017. The co2 emissions will be 17% lower, which represents an approximation to the 25% target for global emission reductions by 2020.

Wood Palletes in Votorantim´s Matto Grosso branch | Source: Votorantim

Votorantim Cement Factory | Source: Votorantim

Source: Votorantim

NEPTUNO PUMPS – AN AWARD-WINNING INNOVATIVE RECYCLING CONCEPT IN IQUIQUE, CHILE

The Center for Innovation and Circular Economy (CIEC) was established in Iquique in 2016 and is a pioneer of its kind in Latin America. CIEC provides consultancy services on circular economy solutions of companies, government organisations, and international agencies. Since 2018 it is conducting a diploma course on Strategies for a Circular Economy, jointly with Universidad Central de Chile.

CIEC has a strong orientation towards ´eco-design´ and product development. The work of CIEC is directed at the following thematic areas: (i) Cities and regions, (ii) education and government, (iii) advanced manufacturing and agroindustry, (iv) water-energy nexus, (v) digital solutions and technologies. One of the prominent products of the CIEC are its Neptuno Pumps.

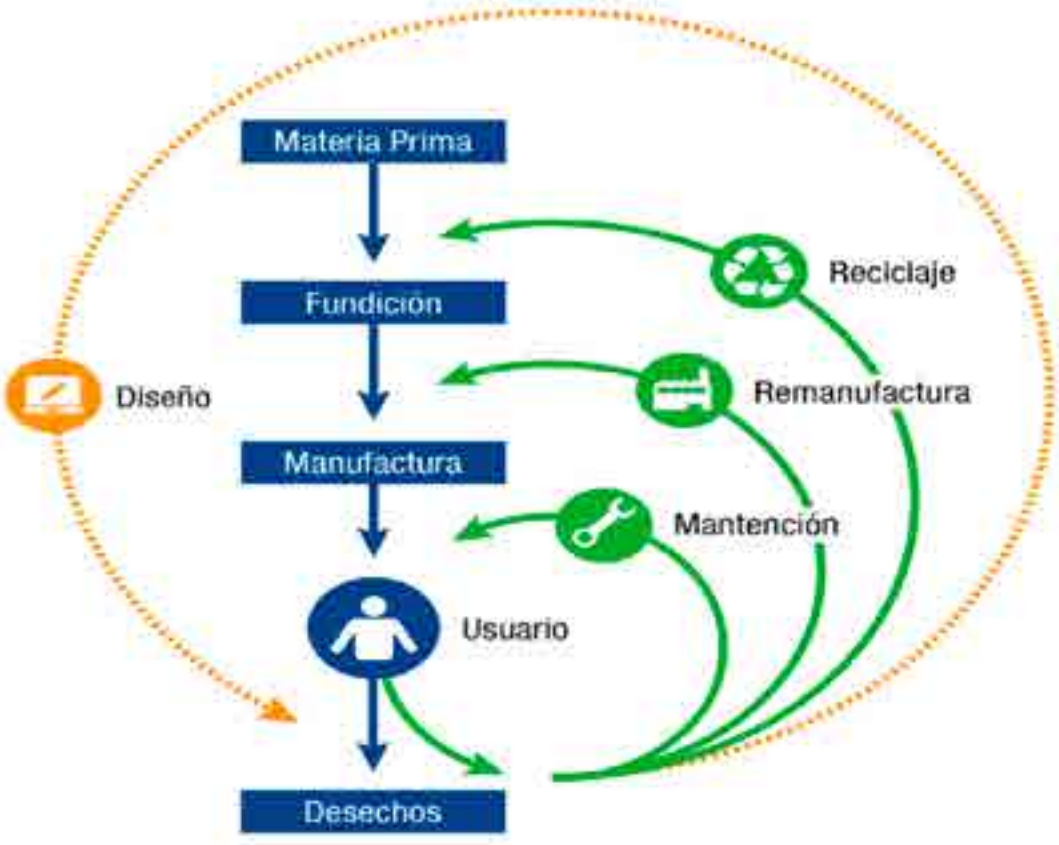
The Neptuno Pumps company designs and fabricates water pumps from recycled materials. 60% of its pumps consists of recycled pumps and other industrial waste products. Neptuno Pumps are designed for use in the mining industry, and facilitate the reuse of 70% of water in the mining process, and lowers energy consumption by 30%. The Neptuno Pumps company recycles damaged pumps and extends their life time through repairs and refurbishment.

In 2016, Neptuno Pumps was selected as one of the 100 most sustainable enterprise solutions, complying with the responsible consumption (objective 12) of and climate action (objective 13) of the United Nations´ Sustainable Development Goals.

Neptuno Pumps VTPX | Source: http://www.neptunopumps.com/

Neptuno Pumps contribute to three development dimensions: the environment, social development, and the economy. Neptuno Pumps reduce energy consumption; they use less water and, thus, increase availability of this scarce resource in the northern part of Chile, and through recycling of industrial waste products they reduce the costs of manufacture. The carbon balance of Neptuno Pumps indicates a 70% reduction of its carbon footprint.

The Neptuno Pumps company has received various international awards: Nastional Innovation Award Avonni 2014 (Category Mining and Metalurgy); The Circulars 2016 at the World Economic Forum in Davos/Switzerland; Award for "Lidership in Ingeneering and Production Technology in en 2014; Award of "Best Local Provider"; Award "Expert Innovator 2014" in the Business Meeting of the Mining Providers; and Award "Foundation Recyclápolis".



Transition Towards A Circular Economy | Source: http://www.neptunopumps.com/

BAVARIA BEER BREWERY – AN EXAMPLE OF A COLOMBIAN GREEN INDUSTRY

Bavaria is Colombia´s biggest beer brewer. It has factories in the cities of Barranquilla, Bucaramanga, Tocancipá, Duitama, Yumbo and Itagüí, and has a production capacity of 26 million hectoliters per year in its six breweries. The beer industry contributes about 1% of the national product, and Bavaria´s share in national industrial production is 2,89%, and 45,92% of the drinks sector.

Bavaria´s production process is distinguished for its co-generation of energy, its use of raw materials, end energy-efficiency. The factory in Tocancipá is the most productive, and La Cervecería del Valle, Yumbo is most modern plant, and owns a photovoltaic system for energy generation. Bavaria´s commitment to the environment dates back to 1993, and was re-enforced in 2005 when it was purchased by the South-African SABMiller multinational company which reinforced savings in water use, energy efficiency, and the promotion of responsible practices like waste recycling, and conservation of the watersheds of rivers in its areas of operation. It works with the World Wild Life Fund for Nature (WWF).

Areas of influence of Bavaria operations on water resources

Biogas system, Tocancipá and waste recycling

Source: Informe de Desarrollo sostenible (Bavaria, 2016)

Bavaria´s modernisation process seeks to establish a cleaner production, and a reduced environmental footprint. Some of its factories already produce their own energy, and since 2008 it has launched a campaign to recycle bottles and lowered the use of raw materials and natural resources. Through its "#Me Uno" (#I Join) programme it has entered into partnerships the Fundación Natura, and the Msc course on Environmental Management (Maestría en Gerencia Ambiental de la Universidad) of the University of de los Andes. Bavaria has also joined hands with various environmental organisations (Agua Somos (Bogotá); Agua por La Vida [Valle del Cauca]; Alianza Biocuenca [Cúcuta]; Fondo de Agua de Cartagena) to protect the country´s water resources. It is associated with the Water Stewardship Assessment (WSA) model.

The environmental work of Bavaria has resulted in an 25% reduction of green-house-gas emissions, and 70% less water consumption. Its medium-term challenges will be further energy savings in its cooling technologies.

RECYCLING OF FUEL BY A LOGISTICS COMPANY IN PERU

The city of Lima generates daily some 8,000 tons of waste, an the municipalities of the metropolitan area find it difficult to manage it effectively. Thus, solid and liquid wastes can be found in the rivers and the Pacific ocean. Restaurants have become one of the biggest polluters of sewage pipes, with growing amounts of fats, oils, and organic substances. Additionally, Lima´s air is among the most polluted. To combat rampant air pollution, since 2011 the use of bio-diesel – mixed into regular diesel fuel – has to be at least 5%. Such bio-diesel originates from soya and oil palms.

Pikango is a medium sized company which is specialized in transport of vehicles. It started operations in 2009, and today counts on 85 trucks which circulate within the whole of Peru. In 2015 it started using bio-diesel produced from vegetable oils. Pikango´s trucks comue about 50 million galons of fuel per month, and 15% of it originate from restaurants. Pikango describes the recycling process as ´colaborative economy´ ("economía colaborativa") since both parties benefit. A win-win situation where restaurants can dispose of their used oils and fats, and the logistics company can reduce its carbon emissions and reduce costs.

The processing of the waste materials into bio-fuel is implemented by a company called Reborn, the only company in Peru which can convert vegetable oils into bio-diesel. Besides waste from restaurants, Reborn also uses motor oil disposed by another company (Cilsa).

Pikango Transport Vehicles

Pikango Transport Vehicles

Source: Juan Alberto Wu, Pikango

Pikango has been seeking the most ecological solution for its transport fleet. It rejected the idea of using gas, since gas is not a renewable energy source, and since bio-diesel creates less emissions. The company demonstrates an environmental management concept that can be interpreted as circular, and through the recycling process it produces savings and positive environmental impacts. Then investment in technology to convert vegetable oils in bio-diesel does not exceed $5,000. Pikango normally mixes 15% bio-diesel into its diesel fuels which is higher than the national norm

CHAPTER 10

SMART CITIES

SMART CITIES – A DEFINITION

A Smart City is one that places people at the center of development, incorporates Information and Communication Technologies (ICTs) into urban management, and uses these elements as tools to stimulate collaborative planning and citizen participation. By promoting integrated and sustainable development, Smart Cities become more innovative, competitive, attractive, and resilient, thus improving lives. Smart city development is connected with smart planning, smart buildings, smart energy systems, smart mobility, smart urban services, smart governance, and smart technologies. Smart finance requires intelligent systems of cadasters and taxation. Smart governance requires shared responsibilities and inclusiveness for private and public actors.

"Smart city technologies add a layer of connectivity to a municipality's infrastructure using sensors on cell phones, cars and other gadgets to collect data and translate it into useful information in apps and platforms that help citizens, as well as local and state governments, make better decisions. According to [a recent] McKinsey's study, increasing the connectivity of Latin American cities could markedly improve the lives of people across a wide range of indicators of wellbeing, including in transit, water and health…"[56] "application of existing Smart City solutions could be used to improve quality of life indicators by 10-30 percent. Furthermore, cutting-edge technologies such as cloud services, advanced analytics, 5G and others are fast emerging, potentially boosting the impact of technology on the quality and sustainability of cities." [57]

THE NEXT STEP FOR LATIN AMERICA

Due to the rapid urbanisation more than 80% of LAC's population lives in cities. [58] Digitalization may still be imperfect and unevenly distributed, but there is significant progress. In less than 30 years, the proportion of people using the internet in the region jumped from 0% to 56%, as opposed to 45% globally. [59] "Smart city technologies add a layer of connectivity to a municipality's infrastructure using sensors on cell phones, cars and other gadgets to collect data and translate it into useful information in apps and platforms that help citizens, as well as local and state governments, make better decisions. According to McKinsey's study, increasing the connectivity of Latin American cities could markedly improve the lives of people across a wide range of indicators of wellbeing, including in transit, water and health… Improvements to quality of life come in many forms. For Latin America, some of the greatest benefits could be seen in areas such as security, mobility, natural disasters, health care and citizen participation… Poor transportation is one of Latin American cities' biggest day-to-day problems, with many citizens spending at least two hours a day commuting to their workplace. Smart technology could substantially improve that. Sensors in cars could not only outline routes to avoid traffic during rush hour, but also pinpoint roads and bridges where infrastructure investment is needed. Moreover, electric vehicles, and eventually autonomous vehicles, will ease traffic, improve the efficiency of city grids and fuel and reduce mortality rates. … [C]itizen security [i]s a key area in which smart technology can be applied in Latin American cities. This includes allowing cities to monitor public spaces and ensuring proper lighting in dangerous areas… [S]mart cities can make people's lives better. Technology can help governments pinpoint problematic areas and develop specific solutions. Individuals would have more free time, be safer, and energy and resources will be used in a more sustainable manner." [60]

56. https://www.thedialogue.org/analysis/smart-cities-in-latin-america-and-the-caribbean/
517 https://www.mckinsey.com/~/media/mckinsey/industries/capital%20projects%20and%20infrastructure/our%20insights/smart%20cities%20digital%20solutions%20for%20a%20more%20livable%20future/mgi-smart-cities-full-report.ashx
58. However, some 27% of this urban population still living in informal settlements.
59. https://blogs.iadb.org/ciudades-sostenibles/en/shaping-smart-cities-in-latin-america-and-the-caribbean/
60. https://www.thedialogue.org/analysis/smart-cities-in-latin-america-and-the-caribbean/

INNOVATION IN THE FIELD OF GREEN INDUSTRIES AND THE CIRCULAR ECONOMY IN LATIN AMERICAN AND CARIBBEAN REGION

Like in other part of the world, in the LAC region is still a very new field. Various city indexes list just a few prominent samples: the 2017 Smart Cities Index lists less than 10 LAC cities on its world-wide top 100 smart cities: Sao Paulo, Rio de Janeiro, Santiago, Buenos Aires, Medellin, Monterrey, Mexico City. [61] Other lists are more comprehensive, like the London School of Economic (LSE) listing of Cities in Motion which mentions Buenos Aires, Cordoba, Rosario, La Paz, Santa Cruz, Belo Horizonte, Brasilia, Curitiba, Rio de Janeiro, Salvador, Sao Paolo, Santiago, Bogota, Cali, Medellin, San Jose, Santo Domingo, Guayaquil, Quito, Guatemala City, Mexico City, Panama City, Lima, Montevideo, and Caracas. [62, 63] "The application of existing Smart City solutions could be used to improve quality of life indicators by 10-30 percent. Furthermore, cutting-edge technologies such as cloud services, advanced analytics, 5G and others are fast emerging, potentially boosting the impact of technology on the quality and sustainability of cities. In LAC, Smart Cities operate at the intersection of these two phenomena and can be seen as an opportunity to deliver benefits to citizens by implementing holistic solutions based on technologies." [64]

IoT industry representatives are positive about the potential of the smart city technologies: "The Latin American smart city market is expected to grow 19.4% per year, reaching US$758bn in 2020, according to consultancy firm Markets & Market. … 85% of the Latin American population will live in urban centres by 2050, which makes it impossible to manage cities using traditional methods. Technology can provide more efficient services and improve citizens' quality of life. [65] "These are some examples that show that LAC cities are already migrating to become Smart Cities. Citizens are already connected, and cities are becoming more innovative and starting to offer smarter services."

61. https://easyparkgroup.com/smart-cities-index/
62. LSE Cities in Motion. https://media.iese.edu/research/pdfs/ST-0471-E.pdf?_ga=2.124147914.137482344.1550676687-1878378055.1550676687
63. Other accounts of progress in individual cities mention the cities of Guadalajara, Monteria, Montevideo, and Vitoria. https://www.fastcompany.com/3022533/the-8-smartest-cities-in-latin-america
64. Inter-American Development Bank. 2018. The Road toward Smart Cities: migrating from traditional City Management to the smart city. file:///C:/Users/Admin/Downloads/The-Road-toward-Smart-Cities-Migrating-from-Traditional-City-Management-to-the-Smart-City.pdf; file:///C:/Users/Admin/Downloads/La-ruta-hacia-las-smart-cities-Migrando-de-una-gesti%C3%B3n-tradicional-a-la-ciudad-inteligente.pdf; file:///C:/Users/Admin/Downloads/Caminho-para-as-smart-cities-Da-gest%C3%A3o-tradicional-para-a-cidade-inteligente.pdf
65. http://www.bnamericas.com/en/news/technology/smart-cities-the-next-step-for-latin-america/

EXAMPLES SHOWCASED

The examples selected to showcase good practices of smart city development are (i) Infomapa – an open source information system in Rosario, Argentina; (ii) the Smart City programme in the municipality of Monteiro Lobato, Brazil; (iii) Strategy of Santiago de Chile to become a smart City; (iv) Cali's Smart City Programme; and (v) environmentally-friendly electric motorbikes in Miraflores, Lima in Peru.

COUNTRY	TITLE	LINK
Argentina	Infomapa – an open source information system in Rosario, Argentina	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Rosario_-_Infomapa_-_Sistema_de_informaci%C3%B3n_georreferenciada_accesible__abierta_y_de_acceso_p%C3%BAblico.pdf
Brasil	Smart City programme in the municipality of Monteiro Lobato, Brazil	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Monteiro_Lobato_-_Ciudad_Inteligente__Humana_y_Encantada_2030.pdf
Chile	Strategy of Santiago de Chile to become a smart City	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Santiago_-_Estrategia_Regional_Santiago_Ciudad_Inteligente_y_prototipo_Smart_City_Santiago.pdf
Colombia	Cali's Smart City Programme in Colombia	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Cali_-_Cali_Ciudad_Inteligente.pdf
Peru	Environmentally-friendly electric motorbikes in Miraflores, Lima in Peru	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Lima_-_Uso_de_motocicletas_el%C3%A9ctricas_cero_emisiones.pdf

INFOMAPA – AN OPEN SOURCE INFORMATION SYSTEM IN ROSARIO, ARGENTINA

Infomapa is a geo-referenced information system publicly accessible to the citizens of Rosario. It has a graphical interface, and data on geography, and physical and urbanistic features of the city. Since it is not static, it offers the opportunity to interact with the city´s departments and service units; it allows operations of zoom, measurement, and search of related data. Citizens can inquire about their bus services, and can download city maps for their purposes.

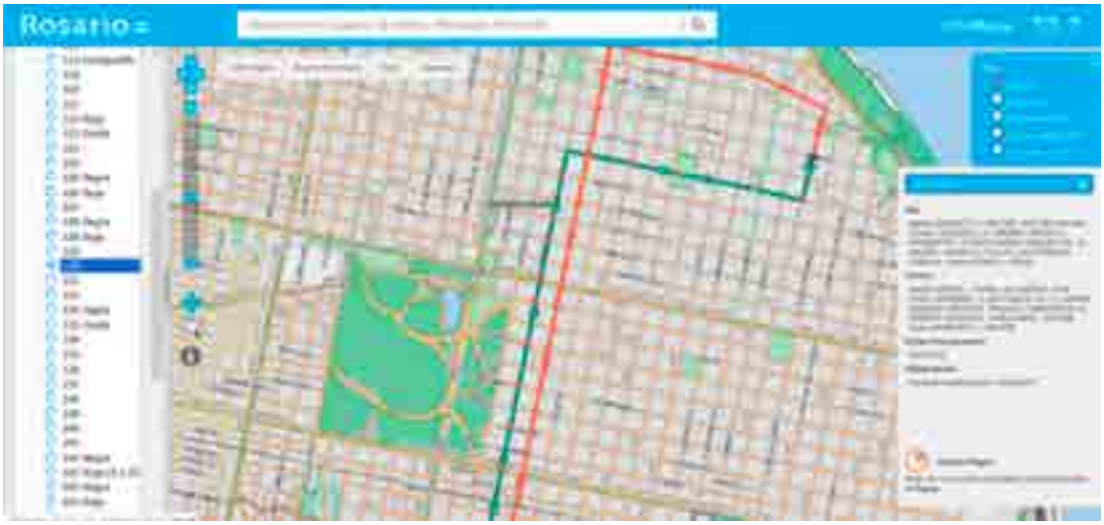
Infomapa was developed by city staff, using free-access software which citizens can easily access and use. Rosario is the first municipality in Argentina to use this inter-active approach towards urban democracy and transparency in its urban management. Information has become a public good for civil society. The system was developed based on Rosario´s decree 951/2009. The data infrastructure includes policies, standards, procedures, technologies available graphically processed. The data bases permit searches, visualization, and evaluation through the catalogues of Infomapa. Currently, Infomapa contains some 1250 maps about the city, among these about mobility, urbanization, services, public spaces, health services, security and culture. Infomapa also offers access to other cities´ information systems. Much of the geo-referenced information base goes back to the digitalization of the cadaster from 1996 onwards.

Infomapa – publicly accessible maps of the city.
Source: Municipalidad de Rosario, http://infomapa.rosario.gov.ar/

The public users can send in requests for information related to the information layers of the maps, and inquire about their neighbourhood (streets, blocks, plots, servcies etc.). This service is available from any web navigator or applications like gvSIG and Google Earth. Since 2017 a special service was inaugurated which permits to download separate layers of the Infomapa system, and these can be requested individually. The beneficiaries are both producers and consumers, service providers and users alike. They can access cadastral maps, transport schedules, names and location of streets and buildings, administrative divisions within the city, urban planning norms, urban services, provincial government services, places of interest, social events, and commercial as well as industrial activities of the economy. The openness of the system permits updating of data and sharing of experiences.

The most recent innovation is the GPS-based public transit information system ("Cuando llega?" [¨when does it arrive´]) which permits public transport to know when their next bus will arrive.

Infomapa is managed by the city´s Dirección General de Informática which depends on the General Secretariat of the city administration. The general directorate for topography and cadaster provides the base information and digitalisation servcies. Infomapa has been financed exclusively through municipal sources.



Geo-referenced Information about arrival of public transport units: "Cómo llego?" y "Cuándo llega?"
Source: Municipalidad de Rosario, http://infomapa.rosario.gov.ar/

Infomapa is a user-friendly tool which can be accessed by anybody. AS digital and online services expand, it is bound to incorporate links to activities of the private sector (cultural and educational events and services), or daily news about service innovations or changes.

SMART CITY PROGRAMME IN THE MUNICIPALITY OF MONTEIRO LOBATO, BRAZIL

Monteiro Lobato in the state of Sao Paulo is on the way to profile itself as an intelligent, human and exciting city by 2030. This perspective contradicts the usual views that smart city development needs to focus on large capital cities. On the contrary, small cities like Monteiro Lobato see technology as an important tool for their own sustainability and development. Smart infrastructure and information technology shall permit them to leapfrog to higher levels of development. The need to innovate and compete has contributed to the creation of its smart city programme.

Monteiro Lobatos´s entry into the smart city development path is related to its strategic planning ("De onde viemos? Onde estamos? Para onde vamos? Para onde queremos ir?") and the definition of its actions related to the United Nations´ Sustainable development goals whose achievements it wants to monitor and document in a participatory manner. The programme of ´Monteiro Lobato: intelligent city, human and exciting by 2030´ seeks to construct integration of human development with a collective form of urban management. Its spatial development shall reflect United Nations Sustainable Development Goals (SDGs), UNESCO´s education for sustainable development (EDS), and an eco-system of innovative technologies which will permit the evolution of the smart city.

Smart City applications in support of a humane and exciting Monteiro Lobato
Source: Monteiro Lobato city administration

In order to monitor the achievement of the SDGs and EDS, the city is developing its indicators and preparing projects to reach targets of reduced transit accidents, access to clean energy, and tourism development which shall enhance social and economic targets. Transformative strategic projects shall align the municipal agenda with the ODS-EDS goals. Smart indicators and citizens´ participation shall ensure the monitoring of the city´s achievements.

Contrary to other cities which bank on the technology side of smart city development, Monteiro Lobato rather likes to put its citizens at center stage. It stresses the Creation of a citizens´ culture of innovation as the challenge. This kind of civil spirit is not available in the Brazil´s cities of today. Thus, citizens´ participation is seen as the key factor to make Monteiro Lobato an intelligent, human and exciting city by 2030.

STRATEGY OF SANTIAGO DE CHILE TO BECOME A SMART CITY

According to the IESE Cities in Motion survey, Santiago is considered the second most intelligent city of South America. This survey reports improvements in environment, urban planning, mobility, and local governance.

In 2015, Santiago launched its Strategic Regional Programme for Santiago to become an Intelligent City ("Programa Estratégico Regional Santiago Ciudad Inteligente") which presents a road map for 10 years. The programme confronts four key areas: mobility, security, environment, and coordination between between urban stakeholders. Some of these projects are (i) Bike Santiago: the first inter-district rental scheme for bicycles; (ii) red and green routes: fast and slow metro routes to reduce travel time; (iii) reversible roads: dynamic traffic flow management as per demand (morning, or evening rush hours); (iv) Formulation of a strategy for Resilient Santiago; (v) Rapid emergency assistance; (vi) Observatory of urban cargo movements; (vii) promotion of smart city services (technology exports); (viii) Air quality monitoring (app for users); (ix) modern solid waste management, (x) promotion of start-ups related to smart city development; (xi) digital toll road payment (´Telepeaje´) based on an electronic customer identification system.

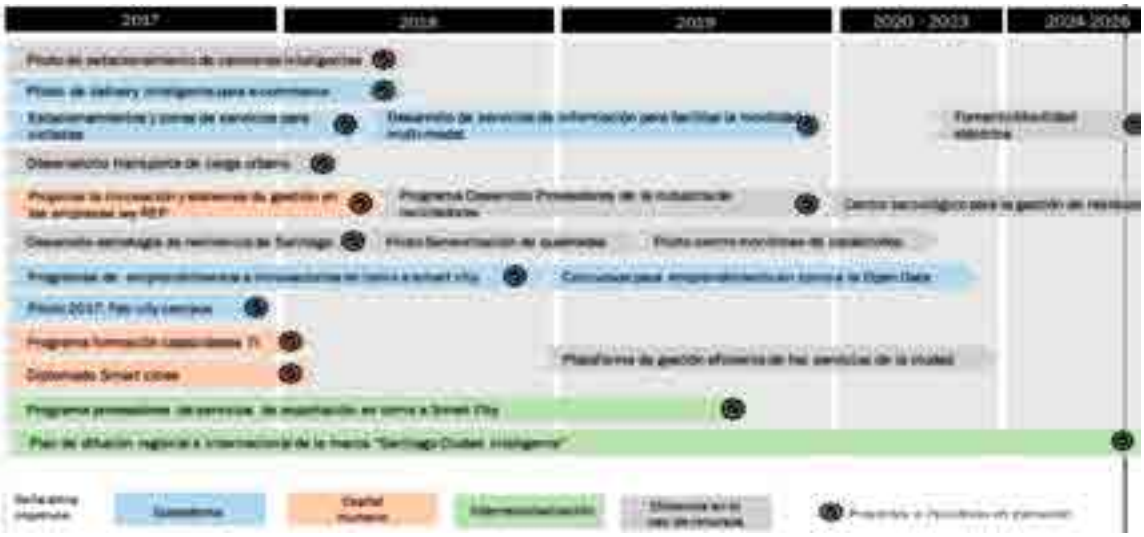
The Business Development Park (Parque de Negocios Ciudad Empresarial) in the district municipality of is the first prototype of a Smart neighbourhood in Chile. It was created in 2014 by the Enel Distribución company. The Park is a centre for technology initiatives in sustainable energy and energy efficiency. Its Technology Center is exhibition place and laboratory for technology prototypes. It works with educational institutions to organize demonstrations and to initiate research activities. Ciudad Empresarial has become exhibition place for urban domotics (artificial intelligence for homes) and energy technologies, and electric mobility.

SmartCity Santiago – Electric car

Centro Tecnológico Interactivo en Parque de Negocios Ciudad Empresarial, Huechuraba

Source: Administración Ciudad Empresarial

The objectives of the Strategic Regional Programme is to convert Santiago into a center of innovation in smart city technologies, to form human resources, and position Santiago nationally and internationally for export of smart city services. The estimated budget for this programme is $3.336.559.241 CLP and includes about 50% privet sector contributions.



Road Map for Implementation of Santiago´s Smart City Agenda
Source: http://www.chiletransforma.cl/wp-content/uploads/2017/08/Informe-PER-Santiago-Ciudad-Inteligente.pdf

Its current achievement is that the interest in smart city development has built up among private companies and the technology organisations. The city administration is positioning the smart city development into its priority areas, although metropolitan Santiago lacks a Metro Mayor, and frequent replacement of elected politicians, municipal managers and technicians remains a challenge. The resources of Santiago – high concentration of population, of GDP, of commerce and industries, and financial and enterprise services -- make it a good ground for innovations.

CALI'S SMART CITY PROGRAMME IN COLOMBIA

Santiago de Cali is Colombia´s fourth largest city. The city has come out to transform its economic role and to build peace and reconciliation into its urban management after experiencing decades of transformations in the rural economy, conflicts and violence. Through strong alliances between the public and private sector, Cali has turned into a city of new opportunities, especially for its large young population, and especially its most vulnerable to the pressures and temptation of narco-traffic.

In 2014 the IESE Cities in Motion study categorised Cali as the most intelligent of Colombia´s cities. In 2016, the Eco-System of Digital Innovation was started with the target to respond to the city´s complex problems in creative and innovative forms, making use of the potentials of collaborations between the university, the local government and private enterprises. In alliance with the Corporación Financiera Internacional (IFC) of the World Bank work was initiated on the Strategic Plan for Information Technologies (Plan Estratégico de Tecnologías de Información [PETI]) which gives impulse to Cali´s model to become an intelligent city.

PETI´s intention is to (i) integrate the different existing information systems of all municipal departments, of the (private) service companies and other urban stakeholders to improve decision making and the services to the citizens of Cali, (ii) serve as a platform of information exchange with the world, to strengthen research, technology transfer, business development, and the promotion of the city. In the four municipal administrations since 2008-2019 some US$55 million have been allocated from municipal and international resources.

Platforms for Collaboration and Co-creation
Source: http://caliescribe.com/es/tecnologia/2014/12/06/7258-ciudad-i-turno-es-cali

TIT@ - Digital Education for all
Source: https://vimeo.com/user32073330

Activities and achiements under the smart city programme are intended to attend to the problems of environmental contamination, mirgation, insecurity, high energy demand, slow mobility and traffic jams:

1. Network of citizens online (red ciudadanía en línea) - www.CiudadanosActivos.com: This network is integrated with Cali´s Orfeo system for documentation of municipal publications.
2. Pannel of government control: This is an instrument

to provide responses to citizens´ querries and inquiries. The pannel is result of a partnership between the municipality and academic institutions.

3. Platform of electronic democracy: This is a portafolio of applications for the internet and mobile phones. It allows citizens to verify municipal actions related to their queries and suggestions.
4. Urban Laboratories of Cali: This initiative is lead by the Observatory of Society, Government and Information Technologies. It is another initiative of academic institutions, which have implemented interactive ´Hackatons´ and campus parties to reach out to the youth of Cali and stimulate their ideas and participation.
5. Digital Education for all (TIT@): This pedagogic platform strengthens the digital culture among youth, teachers, and parents. Its EDUCLIC component, with the help of the private sector, has installed 35.000 tablets in 26 public educational institutions. It brings benefits to about 50.000 children
6. C4 – Center for Security Controls: These smart control centers have been developed jointly with the Secretariat of Technology of Information and Communication (TIC), and the National Police which monitor and supervise the city. The centers own a system analytic video surveillance (´sistema de video analítica´) which uses recognition technology to track down delinquents and vehicle number plates.
7. Health assistance: Citizens receive support through a municipal information network (red municipal integrada [REMI]) which connects them to the main hospitals.
8. Smart Transit Management Center: through the MIO app and a global positioning system (GPS) users can obtain information about the arrival time of public MIO busses. The smart mobility space allows to study the performance of public transport, the identification of number plates and smart regulation of traffic lights.
9. Observatory for the Environment: This system allows the compilation of important environmental and pollution data (for air and water) which reflect the conditions for the well-being of Cali´s citizens.
10. Internet Accessibility: This offers free WiFi to citizens in five emblematic zones and in all public transport stations.

The promotors of the Cali Model of a Smart City ("Modelo de Cali Ciudad Inteligente") consist of an interpretation of the local eco-system and seeks to strengthen the relatins between local government, private enterpises and organized civil society. So far, the constructive relationships between these urban stakeholders have been the success in the advancement of model.

Education and sensibilisation of citizens and youth is a prioritized activity in the implemnetation of Cali´s strategy to become a smart city.

Red Municipal Integrada (REMI)
Source: Alcaldía Santiago de Cali, 2017

Performance Monitoring of Municipal Management (´Rendicion de cuentas´) | Source: Alcaldía Santiago de Cali, 2017

ENVIRONMENTALLY-FRIENDLY ELECTRIC MOTORBIKES IN MIRAFLORES, LIMA IN PERU

Lima faces many environmental challenges, like high noise levels, and is the second most contaminated capital city of North and South America combined. In this context, the municipal district of Miraflores stands out for better noise level and environmental performance. The district has undertaken various projects to monitor and control noise and pollution levels, like cost-free emission test for vehicles.

The recent initiative by the Police (Gerencia de Seguridad Ciudadana) of Miraflores stands out as an example. The Gerencia de Seguridad Ciudadana acquired 15 electric motorbikes of serzo-emissions which are being used for police work in the district. This investment was done under the project of public investment in citizens security ("Proyecto de Inversión Pública Mejoramiento del Servicio de Seguridad Ciudadana del Distrito de Miraflores – Lima – Lima") promoviendo la movilidad sostenible desde la gestión municipal. Electric motorbikes create no noise and cause no co2-emissions. The existing batteries allow for 8 hours of service. They are being used during daytime and charged at nighttime.

The motorbikes are made in China, one of today´s biggest producer of electro-mobility. The operation of these motorbikes is very economical, just below 10% of the petrol costs of previously used equipment.

Electric motorbikes in Miraflores, Lima - Demonstration of charging by the city mayor, Jorge Muñoz Wells
Source: Municipalidad de Miraflores

The purchasing cost of these electric motorbikes is about US$ 5.000 per unit. The saving in operation costs shall be used to purchase additional units, in order to equip the police force with 100% motorbikes.

This experience shows that a municipal district administration can venture on its own into the world of smart and environmentally friendly technologies, and contribute to better environment and more cost-efficient services.

CHAPTER 11

GREEN FINANCE

Land-based financing through property and development taxes have been the mainstay of cities income in recent decades. Other revenue sources have taken back seat. In the context of the continuing and massive urban renewal and modernization of cities, there is a need to develop new non-conventional revenue streams to maintain existing investment dynamics. In order to support low-carbon development in transport, energy sector, buildings, water, waste management, greening of industries, there is also a need to develop green financing tools. Recently, in the LAC region we have observed the first cases of green bonds and other means of financial innovation which may help to put low-carbon urban development on more stable feet. [66]

There is a sequential set of considerations which, if carefully done, will maximize the potential financing envelope for a city. These financing options (i) maximize existing revenue sources and potential new ones; and (ii) leverage additional resources from the private sector. Green finance is a phenomenon that combines the world of finance and business with environmentally friendly behaviour. It is an arena for many participants, including individual and business consumers, producers, investors, and financial lenders. Green finance can be expressed differently depending on the participant, and it may be led by financial incentives, a desire to preserve the planet, or a combination of both. Financial institutions that extend lending to individuals, small businesses, or large corporations can do so in an environmentally friendly manner. In this type of green finance, loans are used to promote the proliferation of renewable energy, for instance. A lender could finance the development of a solar power plant that generates power from the sun, and the installation of solar panels on the roof of a building or residence. Wind power generation is another type of business that would win favour with green financiers. These companies develop expensive wind farms that use large turbines onshore and offshore to capture the wind and generate energy. For the municipal finance context it will be necessary to develop better management practices that make more efficient use of existing revenue collections, or those which offer new income flows. The most promising financing approach that exists seem to be the issuing of green municipal bonds. The ´muni bond´ system has been tested in various countries, but wider-scale applications are yet to happen. [67]

STATE OF DEMAND FOR GREEN FINANCE IN THE LAC REGION

Actively developing green finance seems like an inevitable choice for the LAC region. At the heart of the challenge lie the rules that govern finance. The current rules governing finance have been encouraging brown developments. There needs to be a turnaround of financing instruments which encourage stimulate investor behavior in favor of green investments. With the help of the Inter-American Development Bank (IDB)'s Leveraging Green Investments (LGI) program has designed tailor-made integrated financing strategies which combine financial and non-financial instruments and addresses the different financial barriers and risks associated with energy efficiency (EE) and renewable energy (RE) projects in order to stimulate local private investment. [68]

POLICY DIRECTIONS

"Development banks operating in Latin America and the Caribbean (LAC) are falling far short of playing the key role they need to in spurring economic recovery and sustainable development. Given the significant market failures involved in shifting investment into sustainable infrastructure, and the fact that the region is

66. OECD. 2017. Green Investment Banks Innovative Public Financial Institutions Scaling up Private, Low-carbon Investment. Paris. http://newclimateeconomy.report/workingpapers/wp-content/uploads/sites/5/2017/01/Green-Investment-Banks-OECD.pdf
67. Euroclima. 2017. Climate Finance and NDCs in Latin America: Guide to accessing international funding sources https://issuu.com/euroclima/docs/et_10_en
68. Inter-American Development Bank. 2018. LAC green Finance Facility – Leveraging Green Investments Program. Washington. D.C. https://www.greenfinancelac.org/wp-content/uploads/2018/11/cop_vs7.pdf

in the midst of an economic downturn, development banks are essential to filling a $260 billion dollar annual infrastructure gap and a $110 billion dollar annual gap in financing for climate change. According to our estimates however, development banks provide just $8.7 billion per year in terms of green finance in general, and climate finance in particular is just $5.9 billion per year. [69] Green financial flows from development banks need to be scaled up significantly, and alongside proper governance structures to ensure that green financial flows translate into sustainable development outcomes, i.e. the Sustainable Development Goals (SDGs)." [70]

CURRENT DEVELOPMENTS AND THE FUTURE AGENDA OF THE LAC BANKING SECTOR SUPPORTING GREEN FINANCE DEVELOPMENT

"Total development bank finance in Latin America and the Caribbean has stood at approximately 1.2 percent of GDP per annum since 2003. The emergence of Chinese and Brazilian development banks as lenders to LAC governments has helped fill a gap left by the World Bank in development bank finance in the region.

- Thirty-three percent of all development bank finance in LAC is not green. This significant amount of development bank finance flows into extractive industries, the generation of fossil fuels, and conventional infrastructure projects that can accentuate global climate change, trigger local environmental problems, and adversely impact local communities.
- Green finance is 20 percent of total development bank financing in LAC. Since 2007, green finance has been $61 billion equal to $8.7 billion per year. $5.9 billion of the green finance is for climate mitigation and adaptation." [71]

INNOVATION IN THE FIELD OF GREEN FINANCE IN LATIN AMERICAN AND CARIBBEAN REGION

Like in other part of the world, in the LAC region green finance is still a very young and underrated form of finance. [72] Tax reforms in several countries (Colombia, Chile, Mexico) are targeting polluters and industries which strain the environment. But these initiatives of carbon trading are seen by many as open to abuse, and as too complicated and ineffective to succeed on a massive scale. The development of 'green' bonds has been initiated in other regions (Europe, USA, and China) but has had limited results in the LAC region. Colombia's Bancolombia is the very first private bank to develop green bonds with the help of the International Finance Corporation (IFC) of the World Bank. Mexico has made considerable progress with its green mortgage programme for ecological homes through the national social housing age4ncy CONAVI.[73]

69. Can Green Finance Fill The $18 Trillion Infrastructure Investment Gap?https://www-forbes-com.cdn.ampproject.org/c/s/www.forbes.com/sites/feliciajackson/2018/03/23/can-green-finance-fill-the-18-trillion-infrastructure-investment-gap/amp/
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73. UN-Habitat. 2012. State of Latin American and Caribbean Cities Report 2012: Towards a new urban transition. p.119. https://www.citiesalliance.org/sites/default/files/SOLAC-ProjectOutput.pdf

EXAMPLES SHOWCASED

The examples selected to showcase good practices of green finance are (i) the provincial green credit line in Santa Fé, Argentina; (ii) Brazil´s Climate Fund; (iii) the market for green bonds and social bonds in Chile; (iv) the Green Protocol of financing institutions in Colombia; and (v) bond financing for 'my green home' in Peru.

COUNTRY	TITLE	LINK
Argentina	The provincial green credit line in Santa Fé, Argentina	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Santa_F%C3%A9_-_L%C3%ADnea_Verde_de_Cr%C3%A9dito_Provincial.pdf
Brasil	Brazil´s Climate Fund	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Cobertura_Nacional_-_Programa_Fondo_Clima.pdf
Chile	The market for green bonds and social bonds in Chile	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/ESP_Cobertura_Nacional_-_Mercado_de_Bonos_Verdes_y_Bonos_Sociales.pdf
Colombia	The Green Protocol of financing institutions in Colombia	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Cobertura_Nacional_-_Protocolo_verde.pdf
Peru	Bond financing for 'my green home' in Peru	http://www.iuc.eu/fileadmin/user_upload/Regions/iuc_lac/user_upload/Lima_-_Financiamiento_Bono_%E2%80%9CMi_Vivienda_Verde%E2%80%9D_Para_Nuevos_Proyectos_Inmobiliarios.pdf

THE PROVINCIAL GREEN CREDIT LINE IN SANTA FÉ, ARGENTINA

Green finance pretends to be an effective mechanism for the implementation of projects which can become sustainable not only economically and financially, but also in environmental terms. This is the case with a provincial credit line in Santa Fé. The significant feature of this credit line is its orientation to revenue earning and sustainability. The credit line provides not credit appraisal, but also evaluates the environmental efficiency of the investments it finances.

Since 2015, the provincial government implements its Green Credit line. This credit line permits access to finance for projects which provide technological innovation and reduce negative environmental impacts of productive activities. Particularly investments in the energy sector are the target of this green credit line. Santa Fé has a well-known potential for energy generation with traditional means, but also great potential for new energy alternatives, through biomass and solar power, and to some extent through wind energy. The province of Santa Fé is a major energy distributor, and the existence of a municipal bank which can implement the credit line operations, is an added advantage. Besides energy generation, the credit line can also support investments in production of related equipment, components, and energy-efficiency in industrial enterprises, and equipment which permits access to ISO 50001.

The credit line can finance up to 80% of a project, with the minimum amount being $40.000 (approximately U$S 1400), with durations of 12 to 36 months, and an annual interest rate of 17% administered through the Banco Municipal de Rosario.

Investment in production of outdoor gym equipment which generate energy
Source: https://www.elciudadanoweb.com/programa-linea-verde-la-eficiencia-energetica-en-las-empresas-tiene-credito/

Advertisement for the Green Credit line
Source: http://www.cader.org.ar/santa-fe-relanza-el-programa-linea-verde-de-creditos/

Between 2016-2018 the credit line has financed some 68 projects in various productive sectors, for instance equipment sport equipment which produces energy, an aluminium factory which installed photovoltaic panels for its energy production, or a factory for milk products which produces methane gas from waste materials of its production processes. The use of the effluents of the milk factory permitted a replacement of its petrol fuels currently used for generation of steam. The estimated cost of these 68 projects has been $103.472.979 (=US$ 2.453.603) which indicates that these projects still represent fairly small initiatives.

It is worth highlighting that this experience is kind of test phase for bigger investments to come. It will be important to consolidate these experiences and seek Access to bigger sources for funding for future generations of green investments to come. The challenge will be to disseminate and inform private sector firms about the advantages of green investments.

BRAZIL´S CLIMATE FUND

The sub-programme "Climate Fund – Efficient machinery and Equipment" has been conceived in the context of national programme "Climate Fund" which is one of the national policies to address climate change. The fund was established through Law 12.114 in 09/12/2009, and regulated through degree 7.343 of 26/10/2010. Its objective is the financing of investments designated to mitigation of climate change, through its 10 sub-programmes like urban mobility, renewable energy, solid waste management, building energy-efficiency, etc. The conceptual guidelines of the Climate Fund are fully aligned with Brazil´s commitment to the COP21 Climate Agreement of Paris in 2015 to reduce 37% of its emissions of green-house-gas (GHG) by 2025.

The fund is managed by a Management Committee composed of representatives from the ministries (Environment and others), industry, academic institutions and civil society, and the finance is managed by the Brazilian Development Bank (BNDES) as financial agent for the credit funds.

In June 2018, the sub-programme "Climate Fund – Efficient machinery and Equipment" was launched. Its objective is to finance machinery and equipment with higher energy-efficiency, leading to a reduction in GHG. Soon after the launching of the Fund, R$ 80 million (= US$20 milliion) were approved within the first 2 months, providing funding for 130 small and medium-sized projects. In September 2018, additional R$ 202 million (= US$50 million) were made available. Besides photovoltaic systems, the credit line can finance wind generators, bio gas generators, and inverters. The financing terms under the Climate Fund are fixed 4,5% per year, with an amortization period of 1 to 12 years.

FUNDO CLIMA

The Climate Fund

Solar roofs funded by the Climate Fund

http://www.mma.gov.br/clima/fundo-nacional-sobre-mudanca-do-clima

The main challenge for the Fund is the to generate and maintain interest in climate-related investments which improve energy-performance of the country, and to stimulate an increase in the scale of the programme at national level.

THE MARKET FOR GREEN BONDS AND SOCIAL BONDS IN CHILE

In April 2018, Chile has launched the market for green and social bonds at the Santiago Stock Exchange. This is an innovative initiative which allows companies to finance or re-finance projects with positive environmental impacts, and those designated for the most vulnerable population.

The participating companies are convinced that they need to become more sustainable if they want to remain profitable. Thus, becoming one of the options for investments in projects with social and environmental objectives. Projects which will be accepted as ´green´ projects need to be evaluated and appraised according to the Green Bond Principles developed by the Climate Bond Initiative (CBI).

Private companies represent a very relevant mechanism to achieve the sustainable development goals (SDGs) of the United Nations, and green bonds can be the instrument that provide fixed dividends which can be traded at the stock exchange like debt instruments.

The advantage of these green and social bonds is that they have the powerful potential to contribute to an increase in investments for social or environmental purposes, and that funds can become available at low cost. The first company to issue green bonds has been the Aguas Andinas water company with a value of 1.500.000 UF (approx. US$62.300.000), with an interest rate of 1,8% and term of 7 years, and 3 years grace period, designated to finance projects of the water sector, resilient infrastructure, and treatment of waste water, all aligned with the strategy of environmental and social development.

The State Bank (Banco Estado which is the only state bank in Chile) was the first to emit social bonds which are aligned with reduction in poverty. These bonds issued totaled at US$83.000.000, with an interest rate of 4,25%, and an amortization period of 4 years, to finance productive projects through technology support, aiming at financial inclusion and the economic participation of women, the development of small and micro enterprises, and the acquisition of homes with energy-efficiency label.

Aguas Andinas water company – the first green bonds issuer in Chile | Source: www.elmostrador.cl

The State Bank (Banco Estado) – the first social bond issuer in Chile Source: www.amchamchile.cl

The objective of the green and social bonds is to mobilise funding for investments supports the implementation of the COP21 Climate Agreements of Paris, and to reduce investment risks of sustainable development projects, and to ensure a high(er) rentability than normal. Chile`s bonds model is based on the experiences of the Stock exchange of Luxemburg which offers transparency and reliability.

The challenge of the future will be to market the concept through social media, the internet, and financial media (like Market Watch bulletin) and expand the participation of private investors.

Responsible Investments
Source: http://www.bolsadesantiago.com/actores/Paginas/Mercado-Bonos-Verdes.aspx

THE GREEN PROTOCOL OF FINANCING INSTITUTIONS IN COLOMBIA

The green protocol of the association of financing institutions represents a voluntary agreement of Colombia`s financing institutions signed in 2015. These institutions are members of the national banking association ASOBANCARIA which unites commercial, national, foreign, public and private bank operating in Colombia.[74] This agreement is important in case the signing financing institutions decide to engage in sustainable development projects, giving private investors the required confidence and credibility.

Colombia`s banking institutions have taken up this initiative in 2014 shortly after the heat waves of 2010-11 when a decline in the national GDP was noted and associated with impacts of climate change. It was assumed that the market needed a new focus on environmental sustainability in its urban development activities. Asobancaria sees this green protocol as a pioneering commitment to environment and sustainability. The protocol takes reference to similar protocols in Nigeria, Israel, Malaysia, India y Brazil. Based on Brazil`s protocol - signed in 2009 – ASOBANCARIA has developed several strategies and sub-programmes which offer credits for green investments which take quality of life, sustainable use of renewable natural resources, and environmental impacts into their credit appraisals. The objective is the promotion cleaner production, and more responsible use of natural and renewable resources.

ASOBANCARIA – Promotion of Green Investment
Source: http://www.asobancaria.com/protocolo-verde/

With the creation of the green protocol, ASOBANCARIA responds to market tendencies like the creation of the Sustainable Construction Council of Colombia (Consejo Colombiano de la Construcción Sostenible [CCCS]). Members of the CCCS have built the first green buildings which are landmarks of the sustainability concept in modern construction.

Associated banks of the Green Protocol, like Davivienda, have created credit lines for provate sector firms which have investment projects committed to the environment, mitigation of environmental impacts, and adaptation to climate change. The establishd credit lines provide financing for: (i) cleaner production, (ii) energy-efficiency, (iii) renewable energy, (iv) sustainable infrastructure. For instance, Davidvienda´s credit line offers credits with 12 years amortisation, and amounts above COP $100 millions (approx. US$ 30.000). Project appraisal is done taking into account environmental risks and sustainability.

74. The signatories of the protocol are financial management institutions like Asobancaria, Frankfurt School, Comité de Gestión Financiera del SICLIMA, Ministry of Environment (MINAMBIENTE), US Agency for International Development (USAID), Green Climate Fund (GCF) Readiness Programme, and banking institutions like FINAGRO, BANCOLDEX, FINDETER (Financiera del Desarrollo), FDN (Financiera de Desarrollo Nacional), and commercial banks like Banco Agrario de Colombia, Bancompartir, Bancamia, Banco ProCredit Colombia, Corpobanca, Bancolombia, Davivienda.

Green Credit Lines of Davivienda

Fuente: https://www.davivienda.com/wps/portal/empresas/nuevo/menu/empresarial/no_pare_de_crecer/credito_para_inversion/lineas_verdes/!ut/p/z1/hY69DoIwGEWfhYHR9pN_3YoyCNEoDmIXA6QWEkpJQatvb53VeLebe05yMcUFpn15b3k5tbIvO9PPNLi40cHbpbGzXZHMAZIk-zyL881x7eDTP4CaGX6EgPHpPyTFtK0E0rVAgNwgWIS-B_7cC_3o_Y_0lRtxTBW7MsUUuilzu5mmYVzaYIPWGnEpecdQLQUSDxu-WY0cJ1x8wHgQBcxo9dTEsl7GEP32/dz/d5/L2dBISEvZ0FBIS9nQSEh/

In Bancolombia, another major player in the Green Protocol alliance, the emphasis is on ´green leasing´. Bancolombia uses leasing options for companies with interest in environmental orientation (for instance renewable energy, or energy-efficiency) which need to demonstrate potential in reduction of green-house-gas emissions. Leasing options are available for (i) sustainable construction, (ii) energy efficiency, (iii) cleaner production, (iv) sustainable mobility. Under the leasing programme, the investor can purchase the projects, discounting leases already paid.

Generally speaking, the banks participating in the Green Protocol operate in similar modes, they offer:

- Green credit lines: with attractive terms.
- Eco-efficiency: assessment of relevance of the projects to be financed.
- Risk analysis: environmental and social risks are appraised.

Till end of 2018, Bancolombia had 195 projects in its green credit portfolio, with a a value of COP $745,000,000,000 (= approx. US$ 244 million) in housing and real estate projects, industrial projects with energy efficiency, water supply projects, sustainable energy, among others.

The portafolio of the banking institutions of the Green Protocol, may still be small in comparison to overall lending in Colombia. But it has stimulated important innovations since its lenders need to have an environmental concept and policy, and co2 emission reductions can be proven. The interest rates charged are considered preferential, and affordable. However, the fact that a large part of the small and medium enterprises in Colombia are operating rather informally does clearly indicate the limits of formal banking operations. The formalisation of the economy will be an equally big challenge for the government.

BOND FINANCING FOR 'MY GREEN HOME' IN PERU

Peru´s housing fund, MIVIVIENDA (´my home´), is a public-private cooperation project established with the objective to solve housing problems lower middle-income groups. Housing units financed by MIVIVIENDA were in the range of US$ 8,000 to US$31,500. When MIVIVIENDA was established in 1998, the government injected US$ 700 million from the banking sector. MIVIVIENDA was created as a not-for-profit company. Within 10 years after creation of MIVIVIENDA the housing market had risen to 1,400,000 m2 (up from 600,000 m2 in 1996) and in the same time, mortgage lending went up from US$ 1,150 million in 2002 to US$ 3,438 million in 2008.

In metropolitan Lima, however, the population has increased rapidly and the number of poor households with few basic services living on the outskirts of Lima in informal settlements remains as high as ever. For them, MIVIVIENDA represents an important option. For households with low incomes, MIVIVIENDA has created the "Techo Propio" (´own roof´) programme. This programme subsidizes homes which costs between US$4000 and US$8000 of up to 90 % of their value. In 2006, some 3,000 families received this subsidy, which was the last government attempt to solve the housing problem of the por. Instead, the government´s housing initiative has been reduced to titling of illegally occupied land through the Commission of Formalisation of Informal Property (Comisión de Formalización de Propiedad Informal [COFOPRI]), which by 2018 has provided more than 1,3 million land titles.

Since 2004, Lima has seen a real estate boom. To stimulate more private investment, the government has created several mechanism of incentives for investments. One of these is the green housing bond of MIVIENDA, or Sustainable MIVIVIENDA Bond ("Bono MiVivienda Sostenible" [BMS]) which was launched in early 2018, and has started to be used by various real estate projects, and by individual investors who want to buy or build a home.

According to the BMS guideline, MIVIVIENDA clients can apply for a subsidy when they apply for a BMS housing loan through an accredited financial institution (IFI). IFI are companies of the Peruvian financial system which operate under government supervision for the disbursement of MIVIVIENDA loans. Homes which have incorporate sustainability criterio in design and construction are considered eligible. This implies certification of these homes as sustainable.

Beneficiaries usually have to participate in a project which does have such certification, and afterwards seek the MIVIVIENDA financing. The approval of a MIVIVIENDA loan will depend on paying capacity. The subsidy will be in the range of 2%-3% of the monthly payments, and the preferential interest rate will be start at 6.99% annually which usually means a reduction of S/200.00 (= approx.. US$65) monthly. This subsidy may increase through an additional reduction for good payment discipline.

The green buildings supported under the Green MIVIVIENDA Bonds scheme may require 30% payments in services like water, electricity since these homes own gas heaters, water saving devices, solar water heaters, water saving toilets, and electric lights with low consumption. Currently, in Peru there are some 100 housing projects which are certified with the Green MIVIVIENDA bonds.

The main objective of the Green MIVIENDA bonds is the construction of greener, more sustainable homes, and to promote the establishment of more projects of this nature. The BMS housing units cost between US$16,000 and US$134,000. Up to US$ 112,000 can be financed through preferential rates. The housing bonds take into account the value of the units, and the degree of ´sustainability´ of the unit purchased. Thus, the fund can be very attractive as it reduced monthly payment costs, and allows for the Green Bond subsidy, and possibly a discount for good re-payment performance.

The Green MIVIENDA bonds are likely to become more visible in Peru´s housing market as thye programme expands, and the relatively low investments costs, and reduced costs for services will make it attractive for many home purchasers of the middle class. It is expected that bioclimatic design features will play a bigger role as the programme matures and the certification process becomes more elaborate and demanding. The replacement of gas heating with solar energy may be one of the features of future adjustments.

Source: https://larepublica.pe/economia/1298421-construiran-100-proyectos-certificados-mivivienda-verde-infografia

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