Annex T: Argentina: Sustainable Urban Development

Contents

Part A: Basic data

A1. Project number & name. 2020-14777, Sustainable Urban Development

A2. Interviews. Email correspondence with Mikkel Hall (mikhal@um.dk).

A3. Dates & financial data. 2020-2023, DKK 8.75 million. The project is funded under the MFA budget through the SSC modality, an arrangement that does not allow for investments or costs incurred by the foreign partner. Hence, 84% of the budget is assigned to the 'Danish Authority' (a management team appointed by the City of Copenhagen). Expert focal points are assigned by the City of Copenhagen/Biofos and the City of Buenos Aires/AySA.

A4. Location(s). Argentina: Autonomous City of Buenos Aires.

A5. Partners. Argentina: Autonomous City of Buenos Aires and Agua y Saneamientos Argentinos (AySA). Denmark: City of Copenhagen and Biofos (Wastewater company of greater Copenhagen).

Part B: Purpose and relevance

B1. Purpose. "The main objective is to support ambitious sustainable urban development in Buenos Aires, especially in the key areas of buildings energy efficiency, climate adaptation and waste water management" (MFA, 2020a).

B2. Relevance to partners.

Argentina: The Buenos Aires authorities recognise that their needs match the City of Copenhagen's "world leading expertise"; "All involved partners from Buenos Aires have shown great interest and commitment to cooperation with Copenhagen. ... All three tracks in the cooperation fit into existing administrative plans" (MFA, 2020a: 5). The Project Documents explain at length the merits of: (a) Copenhagen's prize-winning Energy Management System (the first in the C40 network); (b) the City of Copenhagen's 2011 *Climate Adaptation Plan* and 2012 *Cloudburst Plan* (with 300 surface and 130 underground solutions planned or underway), and how its adaptation planning also enhances the quality of life of its citizens; and (c) the success of the Danish waste water utility company Biofos in achieving a positive energy balance in 2014 and a surplus thereafter, using sewage sludge for biogas with the residual material being burned for power, and EE measures throughout.

Denmark: "Danish producers of water and energy efficiency solutions are present in Argentina [including Grundfos for water pumps, Danfoss for thermostats, and Velux for energy-efficient windows] and have expressed a strong desire to [collaborate with the City of BA and AySA" (MFA, 2020a: 5), while "KMD, the provider of City of Copenhagen's EMS/BMS software system, is also interested" (MFA, 2020a: 6). "Gehl Architects have previously worked with the BA administration on urban planning and their potential involvement has been stressed by the BA administration" (MFA, 2020a: 7). After exchange visits, "Both usual suspects such as Grundfos, Danfoss and AVK [valves] and smaller companies like Combigas and [Nissen Energy - biomass turbines] have a strong interest in AySA as a gateway to the Argentinian market" (MFA, 2020a: 8).

Both: the Copenhagen and Buenos Aires city mayors are on the C40 Steering Committee, promising synergy, resources and dissemination of results in Latin America.

B3. Relevance to MDGs/SDGs.

According to MFA (2020a), the project will primarily contribute towards:

- **SDG 6** (clean water and sanitation, especially sub-goals 6A, 6B, 6.4, 6.5, 6.6);
- **SDG 7** (affordable and clean energy, especially sub-goals 7A, 7B, 7.3);
- **SDG 9** (industry, innovation and infrastructure, especially sub-goals 9A, 9.4);

- **SDG 13** (climate action, especially sub-goals 13.1 ["*Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries*"], 13.2 ["*Integrate climate change measures into national policies, strategies and planning*"], 13.3 ["*Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning*"]); and
- **SDG 14** (life below water, especially sub-goal 14.1).

B4. Relevance to NDC mitigation commitments. Argentina's 2016 NDC stresses the country's 92% urban population (well above the regional and global average), and the need to invest in structural and non-structural works to prevent floods, especially in the eastern part of the country (Fundación C40 is mentioned as a key actor under 'Vulnerability reduction' and 'Identification and promotion of good practices and tools for adaptation'). Details of other national and Buenos Aires climate change plans, policies and laws relevant to promoting EE and reducing GHG emissions are given in the *Baseline on Energy Efficiency* (MFA, 2020c).

B5. Relevance to mitigation. Mitigation verification criteria met:

- **Incentives & regulations** (IR) for EE in buildings and equipment, and sewage works, (strengthening of regulatory frameworks related to mitigation, including those to discourage GHG emissions and to remove barriers to or encourage ... investment in reducing GHG emissions).
- **Mitigation technology** (MT) (reducing or stabilising GHG emissions in the waste and sewage management [sector] through application of new and renewable forms of energy), plus technology used in EE efforts.

Part C: Narrative overview

Cities are now home to more than half of all people, and account for about 70% of the world's measured GHG emissions (see **G3**). Each is a potent aggregation of infrastructure, industry, communications, human and financial capital, and voting power, so they are influential in many ways. But they also have special needs in the context of adaptation to climate chaos: 70% of cities are already dealing with the effects of climate change, and nearly all are at risk; and over 90% of all urban areas are coastal, putting most cities at risk of flooding from rising sea levels and powerful storms. But many cities also possess significant autonomy, local accountability and fiscal capacity, so are often able to act more swiftly and flexibly than national governments.

The combination of influence and vulnerability makes cities attractive as entry and intervention points for the climate response. Moreover, many cities are in dialogue through networks such as C40 Cities and UCLG and are cooperating and competing with one another for honour and prosperity in such areas as liveability, sustainability, attractiveness to visitors, public health, and climate mitigation and adaptation (C40 Cities *et al.*, 2019; UCLG, 2019). Thus, effective solutions in one city can spread quickly to others, giving successful projects high leverage and replication potential. An additional factor is that, because cities can often make their own decisions and raise their own finance, there is a special premium on good ideas that directly apply to the local circumstances in each city, so matching the right ideas with the right cities is both a relatively cheap form of development assistance and can be a very effective one.

The Copenhagen/Buenos Aires Cooperation for Sustainable Urban Development project meets all of these implicit and explicit criteria. It is based on longstanding business relationships and mutual respect between the two cities, with both recognising the value of the other in the three specific 'tracks' of the project: (a) better energy efficiency in public buildings, (b) enhanced flood-risk management through socially- and ecologically-aware urban design, and (c) improved wastewater management for energy efficiency and energy capture through biogas and sludge combustion. It has very clear ownership by the city authorities of Buenos Aires and addresses very clear problems that can be solved locally. It is based on the transfer of technology and systems of proven excellence from Danish companies and the City of Copenhagen. It realistically envisions deliverables within three years that will demonstrate cost savings, quality of life improvements, and GHG emission reductions. The whole package is scaleable within Buenos Aires and Argentina, and replicable across Latin America, where other cities are contesting for accolades on sustainable mobility, climate action planning, sustainable waste management, adaptation and resilience, and citizen engagement (see E2). Finally, AySA is a prime example of a large company with mass potential for energy efficiency and for conversion of waste to energy.

While the project started in 2020 and only the planning documents are available, it has good potential for direct and indirect mitigation effectiveness, and strong replication potential. **Overall scores**: 7

(perfect) for design; 6 (very strong) for anticipated performance.

Part D: Design quality

D1. Theory of change.

1. Energy efficiency in public buildings. Energy prices have increased following a cut in subsidies (from 86% to 29% of production cost as of October 2019). Buenos Aires plans to cut energy use in 1,500 public buildings, to save money and reduce emissions. In Copenhagen, Building Management Systems (BMS) and a central Energy Monitoring System (EMS) have proved effective and will be introduced in pilot buildings in Buenos Aires to support business cases for full implementation.

2. Climate adaptation. Buenos Aires is a dense urban environment with few green spaces, making the city vulnerable to flooding from intense rainfall. The city's 2014 'hydraulic plan' made no allowance for climate change and uses less realistic assumptions on flooding risk that Copenhagen's. It is also based on hard measures (underground pipes and reservoirs) rather than green spaces and other surface solutions that can improve the liveability of the city.

3. Wastewater and energy. AySA is majority state and minority labour-union owned, and has monopoly or near-monopoly roles on drinking water and wastewater treatment, with 14.5 million potential customers of which large numbers in the service area are currently without access to sewers and/or tap water. It is also the largest energy consumer in the city, using 117 GWh annually. Biogas from (sewage) digesters is available but is currently flared. Energy optimisation and use of biogas can contribute both to a strong financial future for AySA and to better service provision for the people of greater Buenos Aires.

D2. Assumptions underlying the theory of change.

1. Energy efficiency in public buildings.

- Assumption 1: that the BMS/EMS system is to a significant extent transferable to Buenos Aires.
- Assumption 2: that investments in energy efficiency will translate into reduced energy use, and that this will reduce GHG emissions.

2. Climate adaptation.

- Assumption 1: that a 'hydraulic plan' that provides for more extreme flood risks and events will be more precautionary and more future proof.
- Assumption 2: that additional and/or better-planned green spaces and other surface solutions to increase the city's capacity to absorb surplus water and/or to convey it elsewhere will be an effective way to reduce flood risks while creating multiple social co-benefits.

3. Wastewater and energy.

- Assumption 1: that there is significant scope to cut energy consumption in water delivery and sewage processing.
- Assumption 2: that there is significant scope to generate energy for use or sale from digester facilities.
- Assumption 3: that the owners of an AySA operating with more financial leeway will invest in increasing the quality and quantity of its service coverage rather than seeking a new privatisation deal.

D3. Plausibility of assumptions and links. All the assumptions are plausible. The risk of AySA being privatised in future is considered to be low, since the company was previously privatised unsuccessfully and later returned to public ownership.

D4. General quality of the project design. The Project Document (MFA, 2020a) is more complete in addressing the Wastewater and Energy theme than the workplan (MFA, 2020b), which seems to have accidentally duplicated the Climate Adaptation text. That aside, the two documents between them, supplemented by the background study and baselines (MFA, 2020c), present a strong case that there

are many benefits to be obtained from cooperation between Copenhagen and Buenos Aires, and how this will be done. **Score**: 7.

Part E: Evidence for mitigation performance

E1. Direct effectiveness. If fully effective as planned, significant energy savings in public buildings are likely (especially in view of the fact that it is the city administration that owns the buildings and pays the bills) which may well translate into reduced GHG emissions. Likewise for biogas utilisation an EE savings in WWTPs.

E2. Indirect effectiveness. Replication potential is very high in view of the existing learning network among Latin American cities and the success of the C40 network. The latter's 2019 '100 Cities' report lists nine Latin American cities as success stories: Bogotá, Bucaramanga and Fortaleza for sustainable mobility; Rio de Janeiro for climate action planning; São Paolo for sustainable waste management; Buenos Aires, Medellín and Salvador for adaptation and resilience; Salvador and Zapopan for citizen engagement; and Buenos Aires for inclusive climate action (while Copenhagen is listed for sustainable mobility and clean energy.

E3. Net GHG emission reductions Not estimated.

E4. Impact effects.

Impacts anticipated by the designers for the 'Energy efficiency in public buildings' component: Significant reduction in energy consumption of the city's buildings. Significant reduction of energy costs. BA reach their CO_2 target on the city's own buildings. Improved indoor climate. Reduced employee sick days. Operation of municipal buildings significantly improved. Systematic use of business cases for investments in energy efficiency. Financing mechanisms in place for investments in energy efficiency. General culture of working for energy savings across GCBA [*Government of the City of Buenos Aires*].

Impacts anticipated by the designers for the 'Climate Adaptation' component: Risk of damage from cloudburst reduced in BA. BA uses blue-green solutions for cloudburst management throughout the city. Relevant sectors across the city incorporate adaptation in their general work. City more liveable with more blue and green elements. Widespread recreational use of clean water bodies. Citizens take joined responsibility for adaptation and recreational improvement of the city. Copenhagen has improved capacity to anticipate cloudbursts (based on use of SAT, a satellite- and radar-based warning system developed by Buenos Aires).

Impacts anticipated by the designers for the 'Wastewater and Energy' component: Utilities across Argentina and neighbouring countries learn from AySA. Improved treatment performance across AySA. CO_2 emission reductions. Significant energy savings at AySA. AySA has return on investments within a few years.

E5. Sustainability effects. Most elements seem likely to prove themselves in financial and public relations terms and are therefore likely to be sustainable, with on-going (modest but highly replicable) mitigation effects.

E6. Efficiency issues. Civic pride and local political support are strong (and cheap) amplifiers of effect, so good efficiency would be expected.

E7. Capacity building issues. There seems to have been a long process of dialogue, business ventures, exchange visits etc. which probably contributed to a good awareness on both sides of strengths and weaknesses in capacity and how to correct them. A potential lesson from this project is that gaining a shared appreciation of capacity needs and building a genuine partnership, can take a considerable time. It is much easier to introduce a new activity to an existing relationship based on familiarity and trust, as here, than it is to create a partnership from nothing with new institutions. But if the latter is attempted, it should proceed through sustained dialogue and trust-building by way of small and easy joint activities, followed by more demanding activities like assessing capacity needs and jointly planning how to address them, and only then should more ambitious activities be attempted.

E8. Baseline and monitoring arrangements. Detailed baseline studies exist (MFA, 2020c, G2.1, G2.2, G2.3) and the activities to be undertaken are all specified. No specific monitoring arrangements for

GHG emissions are described.

E9. Overall conclusion on mitigation performance. A score of 6 (very strong) for anticipated performance can be given in the expectation of reasonable efficiency, sustainability and modest but highly replicable impact on emissions.

Part F: Other aspects of design and performance

Part G1: Themes and outcomes of the project

G1.1. Energy Efficiency in Public Buildings.

Outcome A: Buenos Aires achieves significant energy savings and carbon emission reductions through increased focus and strengthened capacity as a result of investments in energy efficient measures in its buildings based on solid business cases. The city has in cooperation with Copenhagen gained better control and overview of energy consumption and knowledge on where to direct investments for maximum impact.

- **Output A.1**: Pilot tests of an Energy Monitoring System (EMS) and Building Management Systems (BMS) are used to support development of business cases at city scale. Buenos Aires Energy Managers have received training in energy efficient building operation through software-based tools.
  - **Indicator(s) A.1**: At least 5 pilot projects on EMS and BMS are carried out based on screening reports of selected buildings in Buenos Aires. The results of the pilots are used to support the development of a business cases for a general EMS and BMS.
- **Output A.2**: Pilots on replacement of energy consuming components and refurbishments of building envelopes. The benefits of a systematic approach to renovate building components are clear to relevant levels of Buenos Aires administration. Based on experience from Copenhagen a database including building components, component lifetimes, and service intervals is being populated. Refurbishment plans and business cases on building envelope and technical components is developed based on overall facility management and asset management plans for building renovation in Buenos Aires.
  - **Indicator(s) A.2**: Minimum 5 pilot buildings have been screened for energy consuming components. Business cases for replacement have been developed with Buenos Aires officials. Most inefficient components in pilot buildings have been replaced with more efficient ones. Tools for overview of technical installations based on Copenhagen experience finalized and adopted by Buenos Aires. Upgrades for building envelope (such as insulation and glazing) are similarly tested in pilot projects.

G1.2. Climate Adaptation.

Outcome B: The City of Buenos Aires has due to the cooperation between Buenos Aires and Copenhagen developed a long term planning method for how to systematically work on climate change adaptation in relation to water issues and at the same time taken advantage of the climate challenge to create more beneficial and sustainable green and recreational opportunities in and around the city. Specific goals are the establishment of a local green pilot project for handling of cloudburst with inspiration from Copenhagen. Furthermore, in the collaboration a vision, strategy and a long-term strategy has been drawn up on how to create the opportunity for recreational use of the water areas, including the value of improved wastewater management, in and around Buenos Aires and increasingly citizen participation on water bodies matters.

- **Output B.1**: Buenos Aires has developed a climate adaptation plan based on natural solutions for flooding and water courses in Buenos Aires.
  - **Indicator(s) B.1**: (a) Buenos Aires has developed climate adaptation plan with input from Copenhagen; (b) Green pilot project is under physical implementation.
  - **Activities B.1**: (a) Exchange of experience with the work on climate adaptation and the development of plans; (b) Sparring on risk analysis, economic analysis and other aspects of adaptation planning; (c) Planning and organizing of work on climate adaptation, water and wastewater; (d) In depth presentation of Copenhagen solutions; (e) Continued work on the adaptation plan and

vision for recreational use of water bodies; (f) Development and feedback on the planning work; (g) Commenting on the first draft for adaptation plan; (h) Continued work on the draft adaptation plan; (i) Commenting on the draft adaptation plan; (j) Concretisation of climate adaptation measures.

- **Output B.2**: Blue-green pilot project for handling of cloud burst. [Learnings from the pilot project will feed into development of the climate adaptation plan (output A.1) and vision/strategy/plan for recreational use of water areas (output A.3).].
  - **Indicator(s) B.2**: not specified.
  - **Activities B.2**: (a) Development of pilot project; (b) Concretization of pilot project; (c) Design of pilot project (d) Implementation of model for citizens participation.
- **Output B.3**: A vision, strategy or a plan has been drawn up on how to achieve the opportunity for recreational use of the water areas around Buenos Aires.
  - **Indicator(s) B.3**: Vision, strategy or plan for use of recreational use of water areas around Buenos Aires has been developed.
  - **Activities B.3**: (a) Strategy for improvement of water quality in river Plata; (b) Sparring on Economic Analysis on Opening & Cleaning Water Courses; (c) Sparring on recreational potential for water bodies and strategy development; (d) Preparation of schedule and identification of needs for investigations; (e) Investigations and planning; (f) Preparation of plan for recreational use of water bodies; (g) Preparation of plan for recreational use of water bodies.

G1.3. Wastewater and energy.

- **Output C.1**: AySA begins optimizing a demonstration wastewater treatment plant (WWTP) based on solid business cases. AySA makes a plan on how to systematically energy optimize wastewater treatment plants and sewer systems across greater Buenos Aires.
  - **Activities/Indicator(s) C.1**: (a) Biofos gives input to a feasibility study on energy improvement of the WWTP, Planta Norte; (b) Identification of specific improvements on EE and energy production of Planta Norte and its catchment area; (c) Development of business cases and tenders for the specific technical improvements at Planta Norte; (d) Assessment of the energy potential by generally upgrading AySA's waste water treatment plants across greater Buenos Aires; (e) Identify funding possibilities for optimization of Planta Norte and general energy optimisation of AySA.

Note on sources

Since MFA (2020b) duplicates the text from B in C in error, it makes no mention of biogas, waste or AySA. However, MFA (2020a) does make clear that a pilot project at AySA Planta Norte will explore opportunities to develop improved sewage treatment and energy capture, potentially yielding energy savings and reduced CO_2 emissions.

Part G2. Baseline studies

G2.1. MFA (2020c): Baseline study on Energy Efficiency (contents, from executive summary).

Buildings and energy data: general building data; energy consumption; meters; EMS (status and objective of SIEGBA [the Energy Information System of the Government of the City of Buenos Aires], other EMS in use locally).

Installations data: type registries/databases; installation data; responsibility in facility, operation and maintenance; BMS ([Building Management Systems] supplier, type, data contents, functionalities of the systems in use).

Governance and policy: climate change plan and other goals for energy savings; energy efficiency law under preparation; building code; who pays the bills (consumption, maintenance, retrofit, refurbishments, new constructions); who has an interest in saving energy, and who can finance energy saving projects.

Stakeholder analysis: relevant GCBA [Government of the City of Buenos Aires] ministries and offices; key external actors; main responsibilities and interests of each stakeholder; relation between the

relevant stakeholders; possible external finance institutions.

G2.2 MFA (2020c): Baseline study on Climate Change Adaptation (executive summary).

Rainwater that falls over Buenos Aires reaches the Rio de La Plata through the heavily anthropized natural environment. As 90% of the area is built it leaves little room for absorbent green spaces. Therefore, the drainage system of the stormwater focuses on the conduction of storm flows through a network of ducts that attempt to replicate the natural system.

In regard to the city of Buenos Aires, 12 basins can be identified which are subdivided into those that drain directly to the Río de la Plata and those that are part of the Matanza Riachuelo Basin that drains to the Riachuelo that finally reaches the Rio de La Plata. With the exception of the Old Radius, where the system is mixed rain-sewage, the rest of the network handles sewage and storm effluents independently. Some of the larger basins, such as Arroyo Maldonado, Medrano or Cildañez are inter-jurisdictional.

The Buenos Aires City Water Plan, composed of several studies and master plans carried out throughout history, consists mainly of structural measures with the aim of achieving network coverage with capacity for storms of 10 years of recurrence when there are areas of the city with coverage smaller than 2 years.

In addition to structural measures, in the last decade, a number of non-structural measures have been implemented progressively. These include the guidelines in the Planning Code, Communication and Education Plans and the Storm Warning System (SAT). These measures are also accompanied by public participation in response to global commitments related to the Sustainable Development Goals (SDGs).

With regard to the actors involved in the Hydraulic Plan, the Executive Power is in charge of the control and construction of the drainage system working with different areas for the execution of the works and the operation and maintenance of the works. Non-structural measures are those that are most closely linked to other areas such as Civil Defense, the Ministry of Education or the Planning Secretariat.

Specifically, in the Arroyo Medrano basin two main problems can be identified. On one hand, the environmental issue linked to the problem of contaminated water from industrial discharges, insufficient sewage network and poor urban hygiene. On the other, the rise of groundwater that brings different problems to the neighbours such as basement floods, problems of foundations in houses, etc.

G2.3. MFA (2020c): Baseline study on Energy in Wastewater (executive summary).

The sanitation system of the Buenos Aires Metropolitan Area is managed by the company Agua y Saneamientos Argentinos (AySA). It serves 17 municipalities in the Province of Buenos Aires and the city of Buenos Aires. It provides coverage to 8.5 million inhabitants representing 2.6 million m^3/day.

AySA responds directly to the National Executive Authority and is controlled by the ERAS (Water and Sanitation Regulatory Body) and programs in coordination with APLA (Planning Agency). On the other hand, it interacts with different actors such as auditors, regulatory bodies, international bodies and other secretariats in addition to direct customers and through different social organizations.

The national regulations impose limits on the quality of effluent discharge to the receiving bodies, for this, the company has a quality control system and a constant monitoring program.

In regard to energy consumption, sanitation processes (treatment and transport) account for 16% of the total of energy consumed by the company, in 2018 the average was 13.2 MWh/day.

The company has a technical team for online monitoring of the use of electricity that issues alerts when consumption does not follow the usual patterns.

The electricity consumed comes mainly from Termoandes, Genoveva, Cammesa and Gas Patagonia as wholesale distributors and Edenor and Edesur as retailers and distributors. Law 27.191/15 on Renewable Energy requires the participation of alternative energies, in this case, it is provided by the wind energy-producing company Genoveva.

Within institutional policies, AySA maintains sustainability commitments through the UN Global Agreement, including SDGs (Sustainable Development Goals) within its plans.

Concerning the North Plant, the secondary treatment system with the project-stage plan on biogas power generation for digesters feedback and the use of sludge for landfarming is remarkable in

partnership with CEAMSE (Ecological Coordination Metropolitan Area State Society).

Part G3. Additional literature

G 3.1. GHG emissions from urbanization and opportunities for urban carbon mitigation.

Abstract (Dhakal, 2010). This paper searches for answers to two broad questions: what do we know about the GHG emissions from urbanization at multiple scales and what are the key opportunities to mitigate GHG from cities and their efficient governance? The review suggests that the quantification of urban contribution to global, regional and national GHGs are limited to few regions and for CO_2 only. The GHG emissions of urban areas differ widely for the accounting methods, scope of GHGs, emission sources and urban definition, thus, making place-based comparisons difficult. The urban system has large indirect carbon flows across the administrative and agglomeration boundaries with important policy implications. We also observed that an integrated system perspective is needed in future studies to integrate all sources, sinks, and opportunities for infrastructure and technology for carbon management. In particular, the multiple benefit assessment of climate change mitigation in cities including the potentials for combined response to the mitigation and adaptation are necessary and the research related to efficient urban carbon governance by ascertaining who can influence the urban carbon mitigation by what extent is important.

G 3.2 Reducing Urban Greenhouse Gas Footprints

Abstract (Pichler *et al.*, 2017). Cities are economically open systems that depend on goods and services imported from national and global markets to satisfy their material and energy requirements. GHG footprints are thus a highly relevant metric for urban climate change mitigation since they not only include direct emissions from urban consumption activities, but also upstream emissions, i.e. emissions that occur along the global production chain of the goods and services purchased by local consumers. This complementary approach to territorially-focused emission accounting has added critical nuance to the debate on climate change mitigation by highlighting the responsibility of consumers in a globalized economy. Yet, city officials are largely either unaware of their upstream emissions or doubtful about their ability to count and control them. This study provides the first internationally comparable GHG footprints for four cities (Berlin, Delhi NCT, Mexico City, and New York metropolitan area) applying a consistent method that can be extended to other global cities using available data. We show that upstream emissions from urban household consumption are in the same order of magnitude as cities' overall territorial emissions and that local policy leverage to reduce upstream emissions is larger than typically assumed.

G 3.3. Urban and rural contribution to the GHG emissions in the MECA countries

Abstract (Ghanbari. & Daneshvar, 2020). In this study, a comparative analysis was presented to detect the quota of urban and rural areas from total GHG emissions in 26 selected countries of the Middle East and Central Asia (MECA) during 1994–2014. For this purpose, 18 independent variables such as land area, population characteristics, energy use and consumption, gross domestic product (GDP), CO_2 emissions, etc., were considered in addition to one dependent variable of total GHG emissions. Statistical modelling to investigate GHG emissions was constructed comprising the quantitative procedures of the correlation test and clustering analysis, which can be considered as the fundamental basis of each econometric analysis. The GHG emissions from the urban (rural) sector of total countries in 2014 were obtained as 3313.4 (1135.6) Mt of CO_2 equivalents, which is about 74.5% (25.5%) of the total GHG emissions (4449.1 Mt of CO_2 equivalents) in the MECA region. The correlation test between GHG emissions and urban indicators revealed the significant records (R from 0.745 to 0.981) compared with rural indicators (R from 0.337 to 0.890). Based on the clustering analysis of the countries, Cluster A, comprised of three countries of Iran, Saudi Arabia, and Turkey, was categorized as countries with very high contributing to the total GHG emissions in the MECA region (~ 43.3%). The quotas of emissions from urban and rural sectors in the Cluster A were estimated as 83.1% and 16.9% from the total GHG emissions in 2014 (1921.3 Mt of CO_2), while the same quotas were predicted as 73.1% and 26.9% from the total GHG emissions in 2030 (1921.3 Mt of CO_2). This study carried out comprehensive research on the GHG emissions from the urban and rural areas in a crucial region of the world, which is faced with the rising growth of population, urbanization, globalization, high-energy use, and fuel consumption.

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