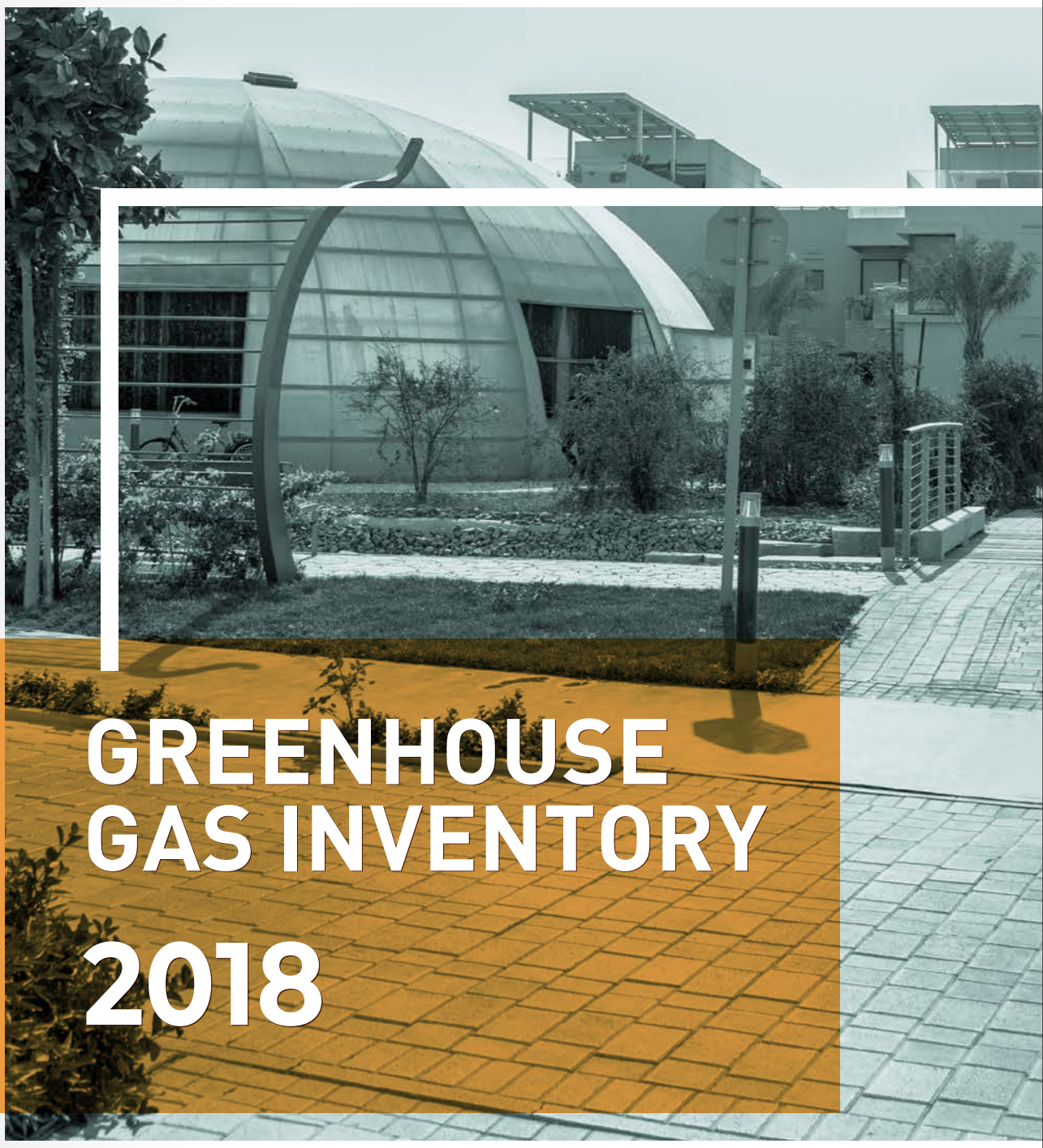
THE SUSTAINABLE CITY



GREENHOUSE GAS INVENTORY

2018

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CONTENT

ABSTRACT

This report summarizes The Sustainable City's greenhouse gas inventory for 2018. This is the second inventory report by The Sustainable City. The inventory follows the Global Protocol for Community Scale Greenhouse Gas Emission Inventories.

Section 1 provides an overview of the climate change challenge and the impact of the real estate sector on global emissions. It also outlines the methodology and presents all the emission sources captured by the inventory. Section 2 presents the emission results, which are further analyzed in Section 3 and compared to the results obtained in the first inventory for 2017. Section 4 identifies three report limitations and articulates recommendations for further emission reduction.

Overall, per capita greenhouse gas emissions in 2018 fell from 5.1 to 4.1 tCO_2e. The significant reduction in emissions is a result of increased solar energy production and some degree of behavior change at the individual level. Although this carbon footprint does not capture all emissions associated with living in The Sustainable City and greater Dubai, it does however demonstrate a viable model for low carbon living, which is compatible with the Paris Agreement and the 2 °C goal.

The ultimate purpose of this inventory is to inspire other communities and developers to follow suit by measuring and disclosing their carbon footprint.

1 INTRODUCTION

BACKGROUND

Climate change is real. Ominously, the year 2018 was the fourth warmest year on record. Keeping global temperature rise below 2ºC above pre-industrial levels, as stipulated in the Paris Climate Agreement, seems more and more improbable and will require transformational changes in society. In fact, our planet is already 1ºC warmer than it was during pre-industrial times, and the cumulative impact of current commitments for reducing emissions are not enough. Human behavior, policies and technologies need to make a drastic change in order to rapidly curb emissions and hold back the global temperature increase nearer to 1.5ºC.

OBJECTIVES

The Sustainable City (TSC) in Dubai is at the forefront of embracing the Paris Climate Strategies and committing to the UN Sustainable Development Goals. This report is the second GHG inventory of The Sustainable City, and it aims to provide an objective and verifiable assessment of GHG emissions in the entire community. Specifically, the inventory:

Discloses GHG emissions in the community

Quantifies principal GHG sources

Identifies opportunities for further GHG reduction

RESEARCH TEAM

This inventory was prepared by SEE INSTITUTE. The research team was responsible for data collection and analysis, computation of results and maintaining contacts with third-party data providers. The GHG Inventory tool was developed in 2017 in collaboration with Emirates Nature-WWF. Dubai Carbon Centre of Excellence (DCCE) appraised the GHG inventory methodology and calculation tools, and verified the results.

METHODOLOGY

This Greenhouse Gas Inventory is aligned with the Global Protocol for Community Scale Greenhouse Gas Emission Inventories (GPC). All five fundamental principles stipulated in the Prot ocol are addressed as required: relevance, completeness, consistency, accuracy, and transparency. The inventory boundary matches the geographic boundaries of The Sustainable City and covers the period from January 1, 2018 to December 31, 2018. It comprises the gases required for reporting under the Kyoto Protocol:

- CO_2 Carbon dioxide
- CH_4 Methane
- N_2O Nitrous Oxide
- HFCs Hydro-fluorocarbons

Table 1. GHG Emissions Sources In The Sustainable City

SECTOR	SCOPE 1	SCOPE 2	SCOPE 3
STATIONARY ENERGY	LPG consumption in the residential and mixed-use areas for cooking purpose Diesel consumption in the generator for telecom tower	Grid-supplied electricity consumption in the residential and mixed-use areas	Transmission & distribution losses from grid-supplied electricity consumption
TRANSPORTATION	In-boundary transportation fuel use Diesel consumption in construction vehicles & machinery Methane and nitrous oxide emissions from biodiesel consumption in construction vehicles and machinery		
WASTE	Methane emissions from sewage treatment plant Methane emissions from grey water treatment plant		Methane emissions from waste disposal in landfill Methane emissions from biological treatment of green waste (composting) Methane emissions from offsite wastewater treatment
INDUSTRIAL PROCESSES & PRODUCTS USE (IPPU)	Emissions from air-conditioning systems in residential and commercial buildings		
AGRICULTURE, FORESTRY AND OTHER LAND USE (AFOLU)	Nitrous oxide emissions from fertilizer application Livestock (enteric fermentation) emissions from the horses at the equestrian center		
OTHER SCOPE			Emissions from consumption of desalinated water

The following gases have been omitted because there are no relevant emission sources in TSC:

- Perfluorocarbons (PFCs)
- Sulfur Hexafluoride (SF_6)
- Nitrogen Trifluoride (NF_3)

These gases are tallied in terms of their Global Warming Potential and are reported in tCO_2e. GHG emission sources are broken down into sectors, such as Stationary Energy, Transportation, Waste, Industrial Processes and Products Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU). The emissions are further classified into three scopes depending on the boundary within which these emissions occur:

Scope 1 All direct GHG emissions (stationary combustion, intra-city transportation, urea application, etc.)

Scope 2 Indirect GHG emissions from consumption of purchased energy (electricity, heat or steam)

Scope 3 Other indirect emissions outside the boundary resulting from activities taking place within the City

The city-induced framework under the Protocol provides for two levels of reporting – BASIC[1] and BASIC+. The latter is more comprehensive as it includes BASIC emission sources plus IPPU, AFOLU, transmission and distribution losses, and transboundary transportation. Emission sources are summarized in Table 1.

Biogenic CO_2 emissions that stem from the use of biodiesel B100 are reported under AFOLU separately from the scopes and other gases, and are not included in the total emissions to avoid double-counting on a national level.

The Inventory covers all significant sources of emissions across the sectors outlined in the Protocol. However, Scope 3 emissions associated with air travel and on-road transportation outside TSC were not included in the inventory due to the difficulty in obtaining the corresponding activity data.

[1] BASIC includes stationary energy emissions (Scope 1 and 2), waste emissions (Scope 1 and 3), transportation (Scope 1)

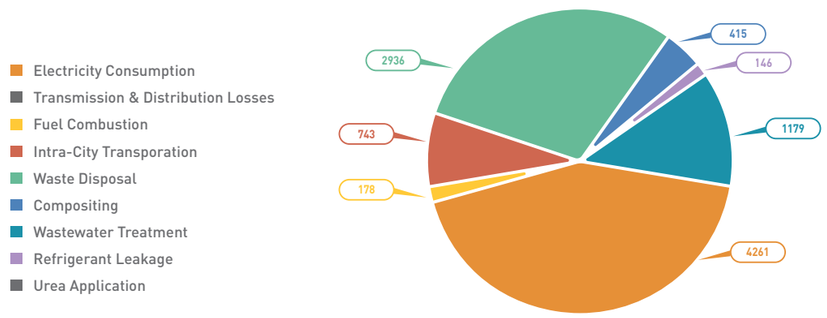
2 RESULTS

DATA MANAGEMENT

Primary data collection is an essential part of the GHG Inventory. The Protocol provides certain criteria for assessing data quality – High, Medium, or Low. For instance, just like in 2017, electricity consumption data collection was the most critical task; for this source of emissions the quality must be high and any modelling is undesirable, and should be obtained from a verifiable and trusted source (i.e., power utility). Most of the data is of High quality as detailed activity data and specific emission factors were used to quantify GHG emissions. The only exceptions are intra-city transportation fuel consumption, diesel consumption in the generator for telecom tower, and externally treated wastewater (all Medium).

In 2018, total GHG emissions in TSC amounted to 10,126 tCO_2e including all emissions from the sources categorized under BASIC and BASIC+ level reporting.

Figure 1. Summary of GHG emissions by subsector, tCO_2e



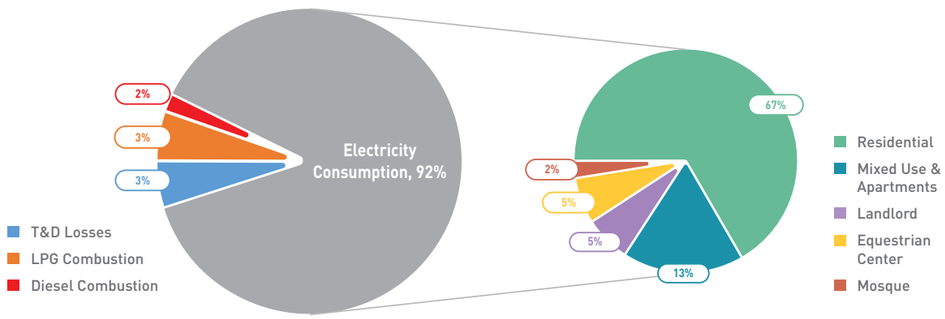
ENERGY CONSUMPTION

The largest emission source – 4,608 tCO_2e – came from energy use (electricity consumption, transmission & distribution losses, use of cooking gas), equivalent to 46% of total emissions.

TSC is grid-connected and the first residential community in the UAE to implement net metering. Diamond Developers designed energy efficient homes to reduce energy use intensity, and installed photovoltaic modules on rooftops to reduce demand for fossil fuel-based grid electricity. Non-residential loads include electric vehicle charging stations, buggy-charging, indoor farming, an equestrian facility, a school, a kindergarten, a mosque, and several retail outlets.

Grid electricity consumption is further broken down by source. Collectively, villas represent the largest consumer of grid electricity, followed by the mixed use area,[2] and the landlord. The Sustainable City has 14 community landlord DEWA accounts which supply electricity for mixed use central cooling, buggy and electric vehicle charging, street lighting, water features, gate barriers, bio domes cooling, wind towers, as well as the swimming pools and community gym. The landlord accounts benefit from a sizable solar PV installation. The equestrian center is also equipped with solar rooftop PV, and solar PV installation in The Sustainable City mosque was grid connected in November 2018, thereby further reducing demand for grid electricity.

Figure 2. Emissions from Stationary Energy, %



[2] The Mixed Use comprises 89 apartments, offices, restaurants, clinics, and retail facilities (but does not include central cooling / HVAC)

WASTE DISPOSAL

The second largest emission source was waste disposal which released 2,936 tCO_2e, equivalent to 29% of total emissions. This includes various types of waste generated by the residents living in villas and apartments, retail outlets in the Plaza, woodchips from the Equestrian Centre, and horticultural waste. In TSC, source separation of household waste is mandatory. Sorted waste is collected by Tadweer, Dubai's largest materials recovery facility, and undergoes secondary sorting to improve the quality of recyclables. In 2018, and according to waste records provided by Tadweer, approximately 84% of total household waste from TSC was diverted from landfills.

COMPOSTING

Composting of green waste and wood chips is done offsite in the premises of Tadweer. This contributed 411 tCO_2e which is equivalent to 4% of total emissions.

WATER CONSUMPTION

Dubai relies exclusively on desalination to meet its fresh water demand. Seawater desalination is energy intensive and therefore has a considerable carbon footprint (22.4076 tCO_2e/MIG). This inventory captures emissions from desalination and is reported as "Other Scope 3."

Emissions due to water consumption reached 1,179 tCO_2e, equivalent to 12% of total emissions. The urban farm in TSC, operated by Leaves & More, uses fresh water and therefore contributes emissions to the GHG inventory. TSC uses treated sewage effluent from Dubai Municipality for landscape irrigation. Water use for landscape irrigation therefore does not contribute emissions to the GHG inventory.

TRANSPORTATION

Internal Combustion Engine (ICE) vehicles are a significant source of direct GHG emissions as a result of fuel combustion. The transportation sector emitted 743 tCO_2e, primarily from private vehicles and construction machinery operated inside TSC, which is equivalent to 7% of total emissions.

TSC was designed to promote zero and low emission transport. For example, TSC residents have access to a fleet of shared buggies to commute inside the city, and which are charged from renewable energy. The city is equipped with Electric Vehicle charging stations to encourage the transition from ICE to EV, and the RTA bus F32 has been servicing the community since May 2017 to encourage public transport.

WASTEWATER TREATMENT

Prior to connection to DM services (2014 – 2018), TSC was recycling its water from two separate streams (grey and black), and treated sewage effluent was reused for landscape irrigation. Starting from April 2018, all the wastewater is diverted for collection and sent for offsite treatment in the Jebel Ali wastewater treatment plant. TSE is purchased through a metered line. The two treatment plants (greywater and sewage) were decommissioned as they were no longer needed.

In 2018, emissions from wastewater treatment activities (both onsite and offsite) were 146 tCO_2e and made up 1.4% of the total.

REFRIGERANT USE

The leakage of a refrigerant gas is a small but significant source of emissions due to a high Global Warming Potential (GWP) value.[M] Emissions due to reported leakage in the air-conditioning systems reached 73 tCO_2e, equivalent to 0.7% of total emissions.

LIVESTOCK

Enteric fermentation, a natural part of the digestive process in ruminant animals, leads to production of methane as a by-product of microbial food decomposition and fermentation. Horses at TSC Equestrian Center released 25 tCO_2e which is equivalent to 0.2% of total emissions.

FERTILIZER APPLICATION

The use of urea as a fertilizer leads to emissions of CO_2 as a result of chemical reactions occurring in the soil in the presence of water. The application of urea for landscapes was the smallest source of emissions – 0.3 tCO_2e which is equivalent to 0.003% of total emissions.

Table 2. Emissions of all sub-sectors according to the GPC standard

Sector	Total By Scope (tCO_2e)			Total by city-induced reporting level	
	Scope 1	Scope 2	Scope 3	BASIC	BASIC+
Stationary Energy	207	4,261	141	4,468	4,609
Transportation	743	N/A	N/A	743	743
Waste	2.4	N/A	3,495	3,497	3,497
IPPU	73	N/A	N/A	N/A	73
AFOLU	25	N/A	N/A	N/A	25
OTHER SCOPE 3	N/A	N/A	1,179	N/A	1,179
TOTAL	1,050	4,261	4,815	8,708	10,126

Sources required for BASIC reporting
Sources required for BASIC+ reporting
Sources included in other Scope 3

Note:
Biogenic CO_2 emissions from combustion of biodiesel B100 were 195.3 tCO_2 and are reported separately from the other scopes as a memo item. However, CH_4 and N_2O emissions from the use of B100 are included in Scope 1 under Transportation.

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ANALYSIS OF KEY RESULTS

Total GHG emissions in 2018 increased by 15.6%, from 8,761 tCO_2e in 2017 to 10,126 tCO_2e in 2018. This increase is normal and expected due to the population increase in 2018. Specifically, the average occupancy of the residential units in The Sustainable City increased from 73% in 2017 to 95% in 2018. Greenhouse gas emissions per capita fell from 5.1 tCO_2e in 2017 to 4.1 tCO_2e. This is a result of higher solar PV uptake and more sustainable practices by residents and employees.

A larger population size increases commercial activity, waste generation, and water use. Despite the population increase, emissions from electricity consumption, transmission and distribution dropped by 4.4% compared to the previous year. This can be attributed to higher PV uptake which reduces demand for grid electricity and increases export, and to a revision of Dubai's specific emission factor for the electricity sector thanks to technological advances at the utility.

*Table 3. Comparison of 2017 and 2018 emissions by sector (tCO_2e)

Sector	2017	2018	% Change
Stationary Energy	5,047	4,608	8.7 ↓
Transportation	254	743	192.5 ↑
Waste	2,485	3,497	40.7 ↑
IPPU	22	73	231.8 ↑
AFOLU	15	25	65.5 ↑
Other Scope 3	938	1,179	25.7 ↑
Total, tCO_2e	8,761	10,126	15.6 ↑
Per Capita (tCO_2e/Yr)	5.1	4.1	19.6 ↓

It should be noted that the community landlord accounts in 2018 benefited from increased PV uptake in the communal car parks. With 2.46 MWp of connected PV in common areas, Diamond Developers (community landlord) was able to offset 79% of total electricity consumption in common areas. This offset is expected to increase in 2019 when additional car parks get grid connected, which will help offset additional loads such as Fairgreen International School.

The equivalent contribution of GHG emissions per capita dropped from 5.1 tCO_2e in 2017 to 4.1 tCO_2e in 2018. This can be attributed to higher PV uptake and electricity production in 2018 compared to 2017, as well as the completion of the wastewater network by Dubai Municipality[3], and behaviour change. It should be noted that the equivalent carbon footprint per capita in The Sustainable City cannot be compared with the total carbon footprint per capita at the country level. Different emission boundaries at UAE and TSC levels render any such comparison inaccurate.

[3] The network eliminates the need to deliver Treated Sewage Effluent to TSC by truck

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REPORT LIMITATIONS & RECOMMENDATIONS

This report has calculated total GHG emissions by The Sustainable City according to the GPC standard. Although the research team took all necessary measures to ensure data accuracy, the following report limitations should be highlighted:

1. Waste disposal (almost 29% of total GHG emissions) was based on an aggregate emission factor for municipal solid waste disposal provided by Dubai Carbon.[4] The emission factor does not distinguish sorted waste from mixed waste, and therefore may overestimate the actual emissions due to the disposal of organic waste. Furthermore, the emission factor assumes that Methane has a Global Warming Potential of 28 over a 100 year time horizon relative to CO2.[5]

2. Transportation (currently only 7% of total GHG emissions) did not capture Scope 3 emissions, linked to vehicle transportation outside TSC. Such data are more difficult to collect and will require additional resources to monitor in the future. Scope 3 emissions from transportation would increase the total carbon impact.

3. Benchmarking GHG inventory for communities is critical to the climate change discourse. In fact, in the absence of other community-scale GHG inventories in the region, it is impossible to benchmark the performance of TSC. Carbon disclosure lies at the heart of the Paris Climate Accord and it is therefore hoped that this inventory, and future emissions inventories by Diamond Developers, will inspire other developers and municipalities to do to the same. In fact, carbon disclosure provides a unique opportunity for real estate developers to differentiate themselves from conventional developers.

Whatever the emission values are, carbon disclosure will incentivize all industries to do better by lowering their carbon footprint. Continuous improvement is essential and paramount to achieving the goals of the Paris Climate Agreement.

[4] The Emission Factor for municipal solid waste is 0.0799 tCH_4/t (equivalent to 1.9975 tCO_2e/t)

[5] The GWP of CH_4 has been revised upwards in successive IPCC Assessment Reports from 21 (AR2) to 25 (AR4) to 28 (AR5). These values are the subject of continued debate.

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***Table 3. Notes:**
Stationary Energy – in 2017 the following emissions were reported under the said sector: grid electricity consumption, transmission & distribution losses, gasoline consumption in construction vehicles and machinery, diesel consumption in construction vehicles and machinery as well as generator of telecom tower, and LPG consumption in the Mixed Use and Villas. **Transportation** in 2018 covered residential car usage within TSC, and diesel and biodiesel (N_2O and CH_4 only) consumption at the construction site as opposed to 2017 when it only included residential cars.

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