Vitoria-Gasteiz Plan against Climate Change 2010-2020. Executive Summary.

Ayuntamiento de Vitoria-Gasteiz
Vitoria-Gasteizko Udala

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BCN ECOLOGIA
Agència d'Ecologia Urbana de Barcelona

Plan against Climate Change 2010-2020

Framework and Objetives

Climate change is one of the greatest challenges humanity has to face in the XXI century. This document presents a strategy to achieve by 2020 a reduction in the emissions of precursors of greenhouse gases (GhG) and a mitigation of the effects caused by climate change through actions on energy efficiency and production. The starting point is the Covenant of Mayors and the objectives to achieve are:

- Reduction of CO_2eq emissions at least a 20% by 2020 compared to 2006 city emissions.
- Reduction of CO_2eq emissions of municipal services and equipments at least a 30% compared to 2006 emissions.

Basic facts

The analysis of energy consumption considers annual GWh consumption and GhG emissions in tCO_2 (referred as tCO_2eq). This diagnosis analyzes the following sectors: residential, services, internal mobility/transport, primary, hydrologic cycle, municipal services and facilities and waste management.

It is important to highlight the increasing number of houses planned for 2020, which explains the increase in the consumption and emissions from both residential and equipment sectors.

	2006	2008	2020
Population	230.585	236.525	256.485
Buildings	100.807	103.808	122.976
Vehicle fleet	132.334	138.777	-

A determining factor in the variation of emissions is the evolution of the national energy mix which has a tendency towards a cleaner electricity generation. This variation explains why although energy consumption increases in some areas, this same increase is not maintained on emissions.

Energy type	2006	2007	2008
Renewable	10,31%	11,24%	12,19%
Natural Gas	23,87%	24,27%	31,86%
Oil	9,10%	7,80%	7,03%
Coal	28,40%	31,03%	20,57%
Nuclear	28,32%	25,67%	28,35%

Definition of scenarios

Six scenarios are proposed:

- Year 2006: Baseline scenario for future comparisons. (BEI)
- Year 2008: Current Scenario.
- Year 2020 T: Trend scenario, without applying any of the proposed actions.
- Year 2020 R: Future scenario applying the actions to reduce consumption.
- Year 2020 R+P: Future scenario applying the actions to reduce energy consumption and promote energy production.
- Year 2020 R+P+S: Future scenario where actions are applied to reduce consumption, promote renewable energy production and computes the effects of CO_2 sinks.

Residential

Year	Consumption [GWh]	Cons/inh [MWh/inh]	% compared to total	Emissions [tCO_2]	Emis/inh [tCO_2/inh]	% compared to total
2006	965,33	4,19	36,4	269.927	1,17	32,1
2008	1.081,54	4,57	37,8	281.372	1,19	33,1
2020 T	1.161,20	4,53	37,7	302.229	1,18	32,7
2020 R	943,61	3,68	43,3	243.963	0,95	37,8
2020 R+P	933,30	3,64	44,1	241.354	0,94	38,6

Actions to reduce emissions

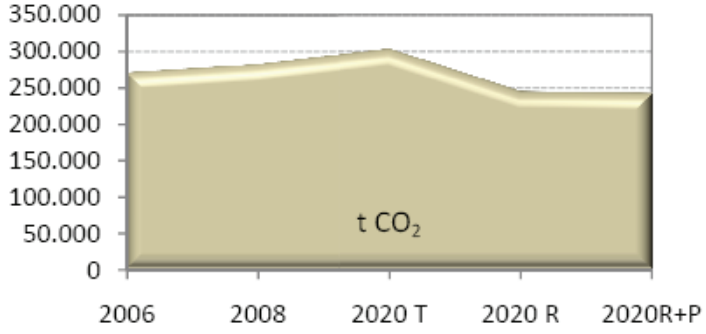
The actions are directed towards the achievement of the maximum efficiency in buildings, with particular emphasis on homes that are in the basic network of motorized traffic (determined by the superblocks). With the renewal of building enclosures, a double objective of reducing noise and heat impact is achieved, as in the current project of the Historic Centre rehabilitation. Actions are proposed for the replacement of boilers, home appliances and lighting for more efficient ones.

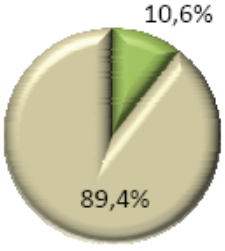
Actions are also directed towards the neighbourhoods with buildings prior to the CTE for changes in building enclosure and in insulations of the building envelope.

Actions for energy production

The increase of solar thermal energy production in the domestic buildings and the promotion of "district heating" in the new urban areas of Vitoria-Gasteiz is proposed. We also suggest the introduction of photovoltaics for the common elements of the building, and geothermal for thermal demand of new residences.

Scenario valuation





Savings compared to 2006

Services

Year	Consumption [GWh]	Cons/inh [MWh/inh]	% compared to total	Emissions [tCO_2]	Emis/inh [tCO_2/inh]	% compared to total
2006	549,64	2,38	20,7	202.227	0,88	24,0
2008	596,11	2,52	20,9	193.127	0,82	22,7
2020 T	706,58	2,75	22,9	229.934	0,90	24,8
2020 R	438,78	1,71	20,1	147.268	0,57	22,8
2020 R+P	435,25	1,70	20,6	146.124	0,56	23,3

Actions to reduce emissions

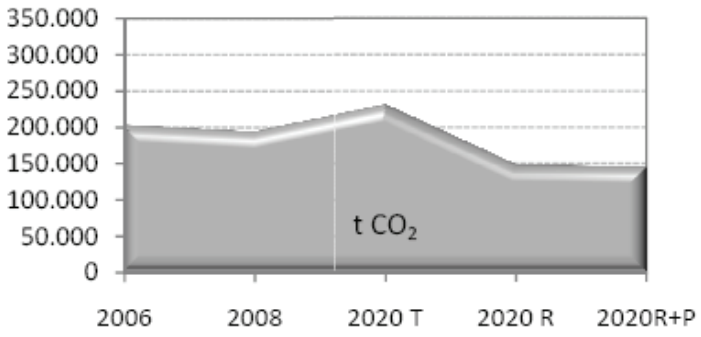
The actions focus on making activities as efficient as possible. With this purpose, renewals of boilers and lighting systems are proposed, as well as the installation of water saving devices with the aid of municipal subsidies.

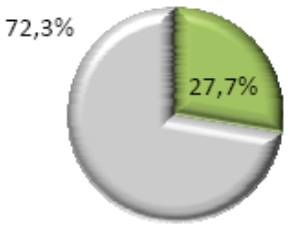
It is proposed to install more efficient engines in high power consumption activities and micro-turbines in high-heat consumption centres. It is required to meet the proposed legislation in the ordinances and regulations, as well as the efficiency criteria for the granting of new licenses.

Actions for energy production

It is proposed to subsidize the implementation of renewable energy production systems in the tertiary sector: solar thermal, solar photovoltaic, small wind, geothermal and biomass technologies (supported by the EVE).

Scenario valuation





Savings compared to 2006

Transport

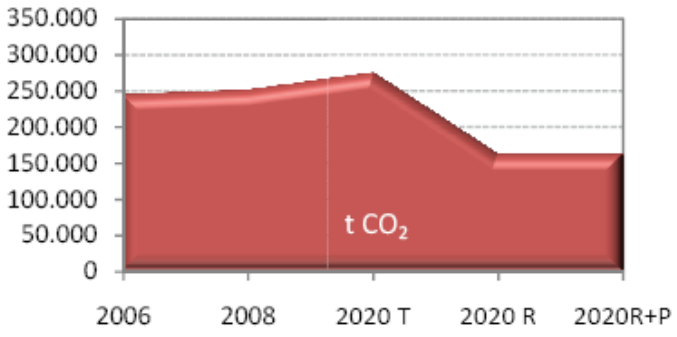
Year	Consumption [GWh]	Cons/inh [MWh/inh]	% compared to total	Emissions [tCO_2]	Emis/inh [tCO_2/inh]	% compared to total
2006	923,53	4,01	34,9	243.971	1,06	29,0
2008	949,45	4,01	33,2	250.586	1,06	29,4
2020 T	1.037,62	4,05	33,7	274.215	1,07	29,6
2020 R	683,32	2,66	31,3	161.044	0,63	25,0
2020 R+P	683,32	2,66	32,4	161.044	0,63	25,9

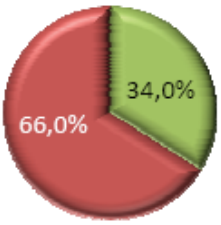
Actions to reduce emissions

The mobility actions evaluate the implementation of the mobility plan which is based on superblocks with the aim of achieving a new modal split. The proposed scenario achieves that only a 23.5% of the travels will be done by private vehicle (36.6% in 2006). This shift should be towards less polluting means of transport: public transport, cycling and walking. Currently a new bus and tram network has been implemented getting a more than 40% increase of users compared to 2006. This measure may be accompanied by technological improvements in the vehicle fleet (hybrid and electric vehicles).

Actions for energy production

Scenario valuation





Savings compared to 2006

Primary

Year	Consumption [GWh]	Cons/inh [MWh/inh]	% compared to total	Emissions [tCO_2]	Emis/inh [tCO_2/inh]	% compared to total
2006	85,15	0,36	3,2	79.421	0,34	9,4
2008	85,15	0,36	3,0	79.421	0,34	9,3
2020 T	85,15	0,36	2,8	79.421	0,31	8,6
2020 R	73,46	0,29	3,4	72.195	0,28	11,2
2020 R+P	46,83	0,18	2,2	62.077	0,24	10,0

Actions to reduce emissions

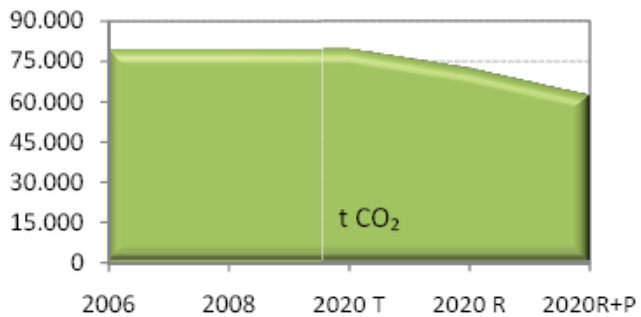
In agriculture, the reduction on emissions aims to be achieved through changing farming practices, involving less use of machinery, reducing the use of fertilizers and chemicals, and switching to biofuels. One of the proposals to reduce and optimize the use of fertilizers is the use of legumes as “green manure”, along with the use of livestock waste and compost.

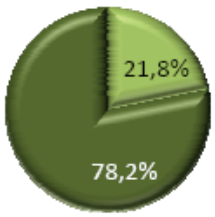
Regarding livestock, it is proposed extensive exploitation for sheep and cattle and silvopastoral systems for horses and goats.

Actions for energy production

Energy production in the primary sector is based on the use of forest biomass and agricultural waste. Furthermore the production of biogas from livestock waste is proposed.

Scenario valuation





Savings compared to 2006

Hydrologic Cycle

Year	Consumption [GWh]	Cons/inh [MWh/inh]	% compared to total	Emissions [tCO_2]	Emis/inh [tCO_2/inh]	% compared to total
2006	11,20	0,05	0,4	5.939	0,03	0,7
2008	11,48	0,05	0,4	5.088	0,02	0,6
2020 T	12,24	0,05	0,4	5.449	0,02	0,6
2020 R	10,80	0,04	0,5	4.901	0,02	0,8
2020 R+P	10,80	0,04	0,5	4.901	0,02	0,8

Actions to reduce emissions

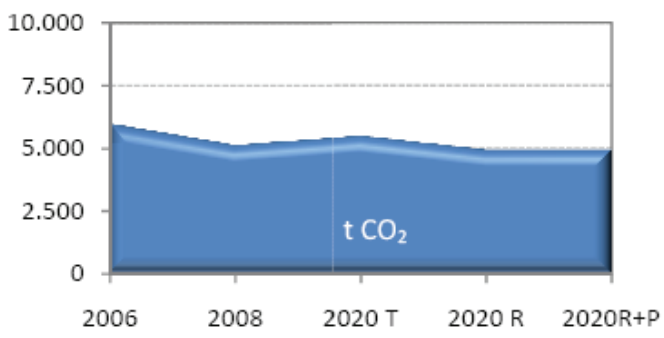
The proposals presented for the hydrological cycle are aimed at minimizing water consumption by reducing consumption in urban areas, water recycling and use of rainwater in new developments. It is also considered the reduction of the influent flow in the WWTP.

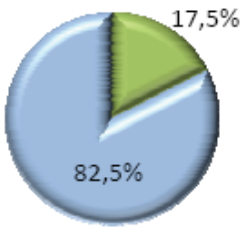
Actions for energy production

In Alava there are two hydroelectric plants, Sobrón and Barazar, which together have a capacity of 113 MW and generate approximately 500 GWh / year.

There are also several mini-hydro plants with a 21.6 MW capacity and generate about 50 GWh/year. All these infrastructures are outside the municipality of Vitoria-Gasteiz.

Scenario valuation





Savings compared to 2006

Municipal equipments and services

Year	Consumption [GWh]	Cons/inh [MWh/inh]	% compared to total	Emissions [tCO_2]	Emis/inh [tCO_2/inh]	% compared to total
2006	118,24	0,51	4,5	37.507	0,16	4,5
2008	131,22	0,55	4,6	38.089	0,16	4,5
2020 T	152,12	0,59	4,9	44.239	0,17	4,8
2020 R	104,28	0,41	4,8	26.850	0,10	4,2
2020 R+P	85,35	0,34	4,1	20.882	0,08	3,4

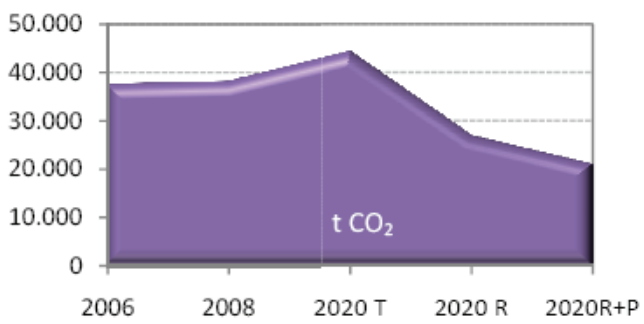
Actions to reduce emissions

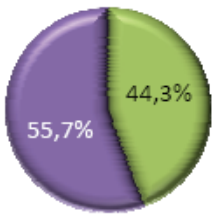
The actions of this sector address four areas. Public transport and municipal fleet incorporate cleaner technological improvements (hybrid and electric). Equipments should reduce their consumption by improving their thermal envelope (green roofs), technical improvements in lighting, water and climatization, as well as management measures and best practices of use. Concerning the public space, actions for the renewal of luminaries are proposed, as well as the adequacy of their timing and voltage regulation. It is also proposed the use of generated compost as fertilizer in the municipal gardens and parks.

Actions for energy production

The development and adoption of an energy ordinance is proposed to enhance the potential of solar energy (photovoltaic and thermal), both in equipments and in industries.

Scenario valuation





Savings compared to 2006

Waste management and urban cleaning

Year	Consumption [GWh]	Cons/inh [MWh/inh]	% compared to total	Emissions [tCO_2]	Emis/inh [tCO_2/inh]	% compared to total
2006	10,59	0,05	0,4	5.832	0,03	7,0
2008	22,63	0,10	0,8	8.640	0,04	1,0
2020 T	-47,01	-0,18	-	-2.503	-0,01	-
2020 R	-48,03	-0,19	-	-4.075	-0,02	-
2020 R+P	-50,04	-0,20	-	-4.090	-0,02	-

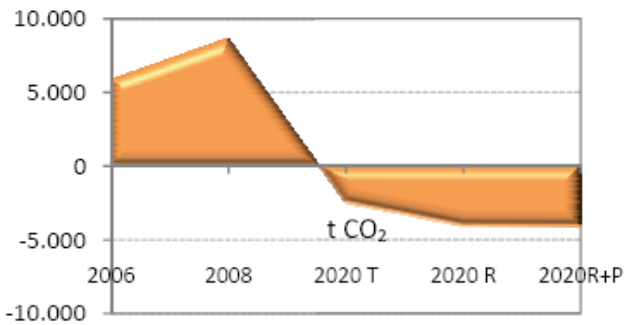
Actions to reduce emissions

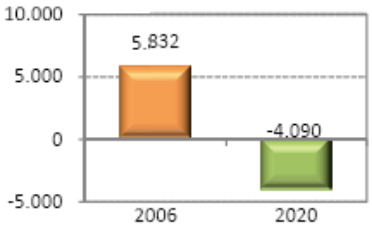
Within the GhG reduction plan of the waste management and urban sanitation sector, in addition to the actions from the implementation of the Municipal Waste Management Plan, where prevention and also material and energy valorization goals are proposed, new additional actions are included, focused in the improvement of waste collection mechanisms and the optimization of urban cleaning services through the introduction of cleaner fuels and technologies, continuous improvement plan, etc.

Actions for energy production

The actions for energy production arising from the management of the municipal solid waste enhances the methanization of organic matter, the energetic valorization of the rejected waste from the mechanical biological treatment plant through the production of solid recovered fuel (SRF) and the processing of biodiesel from the used domestic oil collected in the municipality.

Scenario valuation





Savings compared to 2006

Municipality

Year	Consumption [GWh]	Cons/inh [MWh/inh]	Emissions [tCO_2]	Emis/inh [tCO_2/inh]
2006	10,59	0,05	5.832	0,03
2008	22,63	0,10	8.640	0,04
2020 T	-47,01	-0,18	-2.503	-0,01
2020 R	-48,03	-0,19	-4.075	-0,02
2020 R+P	-50,04	-0,20	-4.090	-0,02

Actions to reduce emissions

The following emission reductions are achieved applying the previous reduction actions:

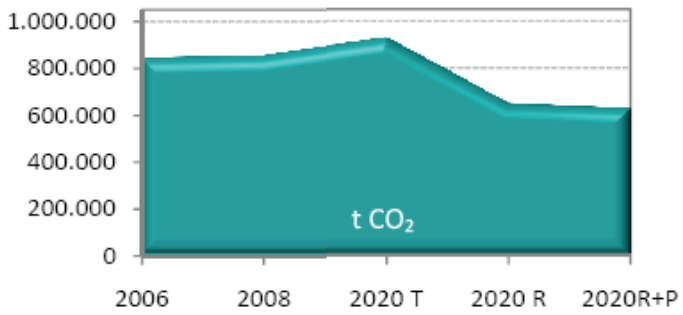
Sector	% Reduction compared to 2006	% Reduction compared to 2020 T
Residential	9,6	19,2
Services	27,2	36,0
Transport	34,0	41,2
Primary	9,1	9,1
Hydrologic Cycle	17,5	10,0
Municipal equipments	28,4	39,3
Waste management	169,9	62,8
Total	**23,4**	**30,3**

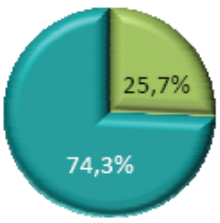
Actions for energy production

The emissions (tCO_2) reduced by the production of renewable energy are the following ones:

Energy source	Production 2008 [GWh]	Production increase 2020 [GWh]	% Emisión reduction by renewables [tCO_2]
Solar termal	3,30	10,25	2.078
Solar photovoltaic	0,91	11,89	4,519
Small wind	0,05	1,12	426
Biomass	10,61	28,64	10.665
Others	17,67	9,51	2.698
Total	**32,54**	**61,41**	**20.386**

Scenario valuation





Savings compared to 2006

CO_2 Sinks

Total GhG fixed [tCO_2/hab]						
Scenario	**Forests**	**Crops**	**Pastures**	**Urban Green**	**Green Roofs**	**Total**
Current	141.390	4.314	567	14.275	0	160.546
Proposed	141.390	4.314	567	16.823	10	163.104

Fixation capacity of the territory

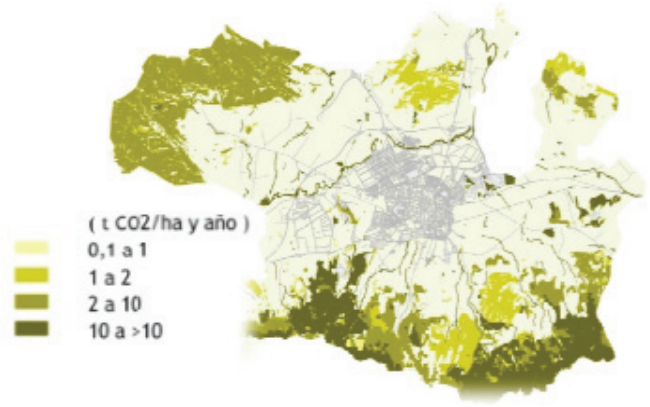
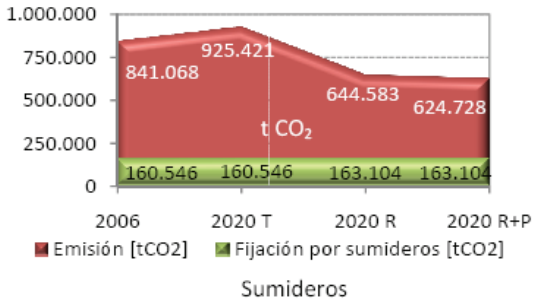
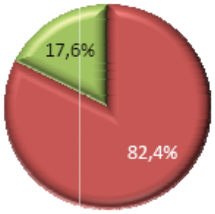


Fig 1. t CO_2/ha and year fixed by forest biomass

Fig 2. Urban green surfaces

Valuation of the actions





CO_2 uptake compared to 2020

Conclussions

The evolution of energy consumption and CO_2 emissions of the territory are shown in the table below, where actions to reduce emissions and to produce renewable energy have been considered:

Vitoria-Gasteiz						
Year	Consumption [GWh]	Δ 2006	Cons/inh [MWh/inh]	Emissions [tCO_2]	Δ 2006	Emis/inh [tCO_2/inh]
2006	2.649,69	-	11.49	841.068	-	3,65
2008	2.858,58	7,9%	12,09	851.223	1,2%	3,60
2020 T	3.081,96	16,3%	12,02	925.421	10,0%	3,61
2020 R	2.181,29	-17,7%	8,50	644.583	-23,4%	2,51
2020 R+P	2119,88	-20,0%	8,26	624.728	-25,7%	2,44

The evolution of consumption and emissions in the local level fields (water cycle, waste management, municipal equipments and services) is shown in the following table:

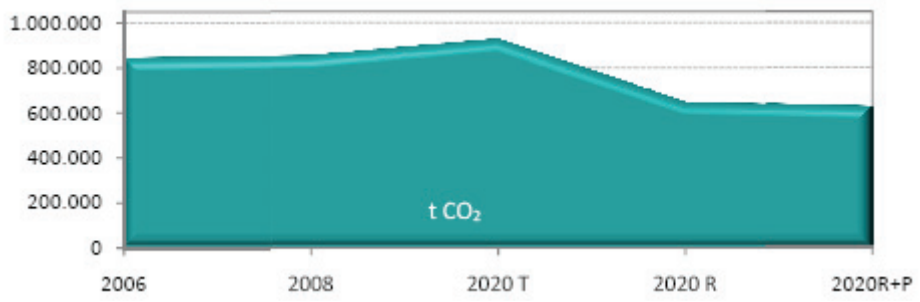
Municipal fields						
Year	Consumption [GWh]	Δ 2006	Cons/inh [MWh/inh]	Emissions [tCO_2]	Δ 2006	Emis/inh [tCO_2/inh]
2006	140,03	-	0,61	49.278	-	0,21
2008	165,33	18,1	0,70	51.817	5,2%	0,22
2020 T	117,35	-16,2%	0,46	47.185	-4,2%	0,18
2020 R	68,05%	-51,4%	0,27	27.676	-43,8	0,11
2020 R+P	47,11	-66,4%	0,18	21.693	-56,0%	0,08

General valuation of the actions

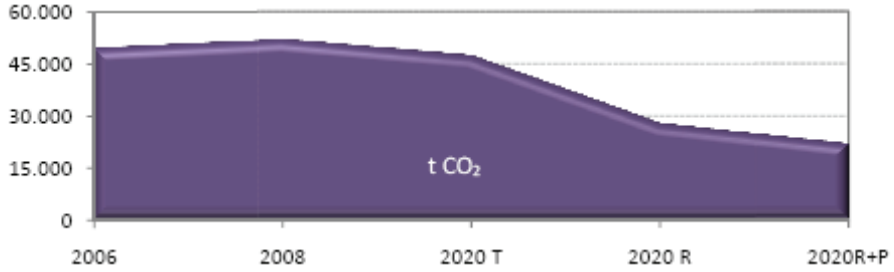
The Municipality of Vitoria-Gasteiz currently emits **841.068 t CO_2** per year regardless of the industry. Considering a trend scenario, in 2020 the municipality would emit **925.421 t CO_2**. If the proposed mitigation measures were implemented, **280.838 t CO_2** per year would not be delivered. Also, if the actions to produce renewable energy are considered, **19.855 t CO_2** would be saved. Sinks increase the CO2 sequestration in 2.558 tonnes, achieving storage of 163.104 t CO_2. In short, even not considering the uptake of sinks, the full implementation of the plan would achieve savings of **463.797 t CO_2** in the 2020 T scenario, which means that in the 2020 R+P scenario GhG emissions would be reduced by **25,7%** over the base scenario (BEI). Emissions per capita would reduce from 3,65 in the 2006 scenario to **2,44 t CO_2/hab.**

If we focus on the municipal competence areas, the reduction and production actions would save up to **56.0%** of CO_2 emissions.

Municipal emissions



Emissions of municipal competence areas



Comparison with other world cities

Different cities around the world are elaborating plans to reduce CO_2 emissions. Even if the calculation methodology of emissions can substantially differ, the implementation of the actions of reduction, production and increase of sinks surface would put Vitoria-Gasteiz on the forefront of carbon-neutral cities.

City	Reduction objectives
Donostia	Reduction of 6% by the 2008-2013 period to achieve 4.7 t CO_2/inh.
Madrid	Reduce GhG emissions by 14% compared to 2004 for the 2007-2012 period and improve the energy efficiency of the City Council.
Stockholm	Reduction of 25% of CO_2 emissions compared to 1990. The aim is to leave fossil fuels aside by 2050. The current consumption per inhabitant is 3.62 t CO_2, but by 2015 the goal is to reach to a maximum of 3 t CO_2 per capita.
Vancouver	Reduction of 20% on the municipal services by 2010, and 33% by 2020.
Phoenix	Reduce the GhG emissions from municipal services a 5% by 2015 compared to 2005. For the 2000-2040 period a 50% reduction of CO_2 emissions is expected.
Copenhague	Reduction of 20% for the 2005-2015 period, emitting 3.7 t CO_2 per capita and becoming by 2025 the first carbon-neutral city.