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The Role of Impact Assessment
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ASSESSMENT OF ENERGY PRODUCTION FROM WWTP IN BRAZIL

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INTRODUCTION

GhG reduction and electricity generation

Innovative Routes

Fuel Cell

Fuel

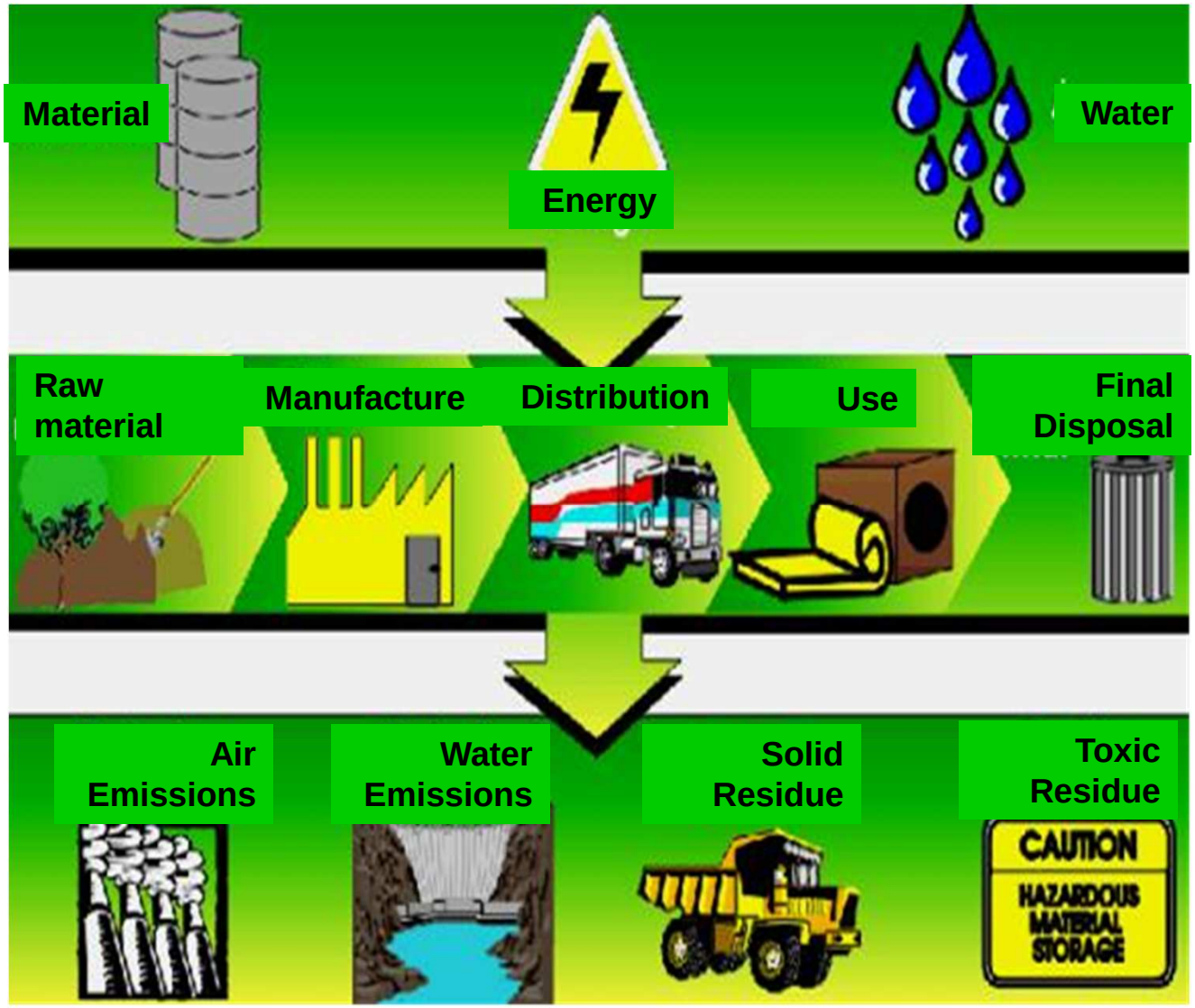
Sabesp (2011)

LIFE CYCLE ASSESSMENT (LCA)

INTRODUCTION
System Description

- ✓ **WWTP Suzano - Metropolitan Region of São Paulo City – São Paulo State - Brazil**
- ✓ **350,000 inhabitants**
- ✓ **69,120 m³ per day (800L/s)**
- ✓ **Conventional treatment technology with activated sludge**

METHODOLOGY AND ASSUMPTIONS



METHODOLOGY AND ASSUMPTIONS

- ✓ **LCA Methodology – Standards ISO 14040:2006 and ISO 14044:2006**

- ✓ **LCA Methodology Phases:**
  1. Goal and Scope definition;
  2. Life Cycle Inventory Analisys – LCI;
  3. Life Cycle Impact Assessment – LCIA;
  4. Interpretation

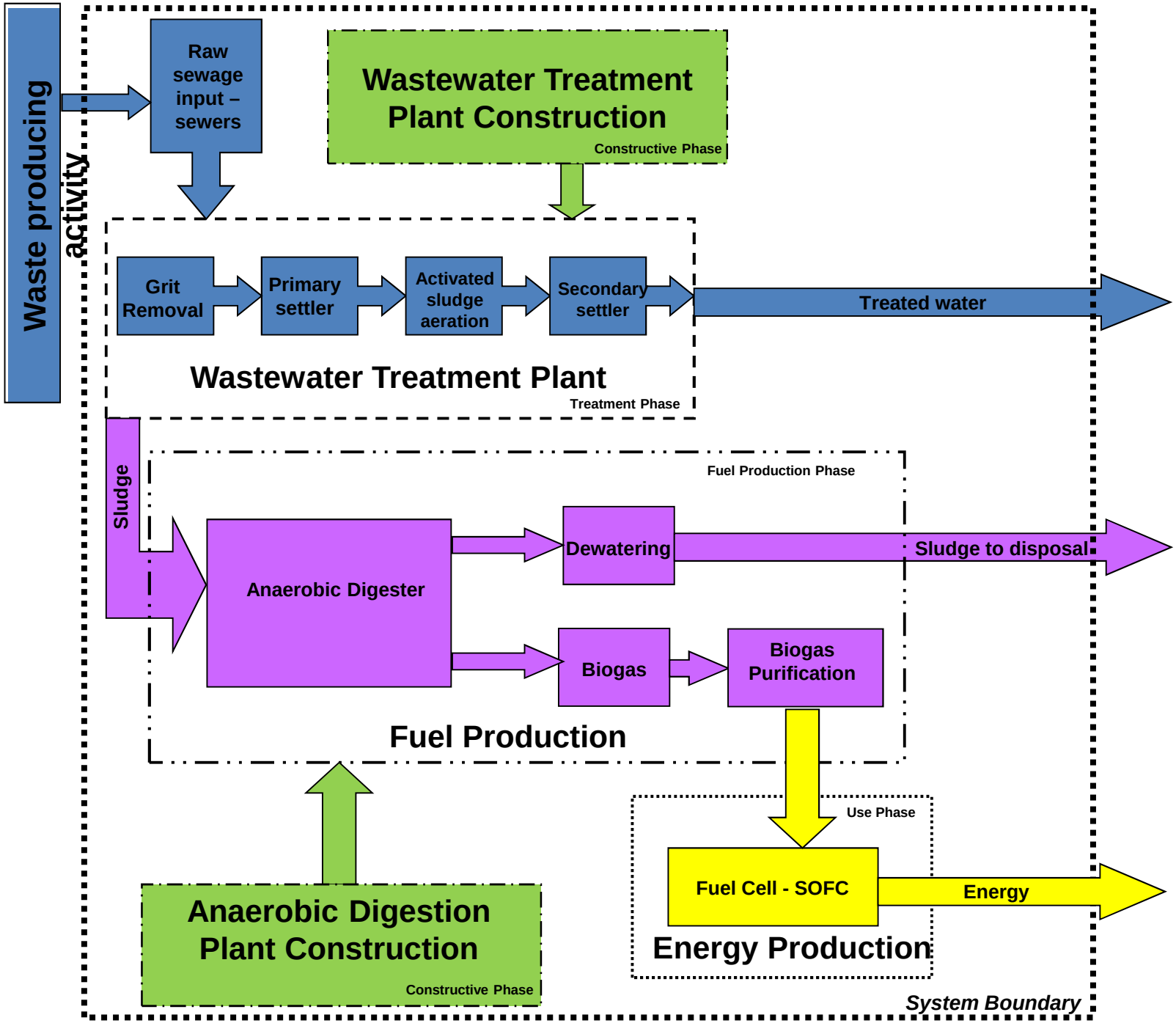
GOAL

Identify the activities in the life cycle of WWTP Suzano and Solid Oxide Fuel Cell (SOFC) technology making the largest contributions to energy consumption and CO_2 emissions, in order to point out the potential of reducing the environmental burden by using biogas as fuel for SOFC.

SCOPE

Included manufacture, facilities construction; operation and final disposal of solid waste from WWTP and SOFC.

Focus: on materials and energy consumption.


Waste producing activity
Raw sewage input – sewers
Wastewater Treatment Plant Construction
Constructive Phase
Grit Removal
Primary settler
Activated sludge aeration
Secondary settler
Treated water
Wastewater Treatment Plant
Treatment Phase
Sludge
Fuel Production Phase
Anaerobic Digester
Dewatering
Sludge to disposal
Biogas
Biogas Purification
Fuel Production
Use Phase
Fuel Cell - SOFC
Energy
Energy Production
Anaerobic Digestion Plant Construction
Constructive Phase
System Boundary

FUNCTION

Treat domestic wastewater to an acceptable discharge standard to natural environment, fulfilling the production of biogas and energy.

FUNCTIONAL UNIT

The quantity of energy produced (MJ) per m^3 of sewage effluent that will be treated in the WWTP.

LIFE CYCLE INVENTORY

Data collection: inputs and outputs for all processes (energy, raw or auxiliary materials, products, co-products, waste and emissions to the air, soil and water)

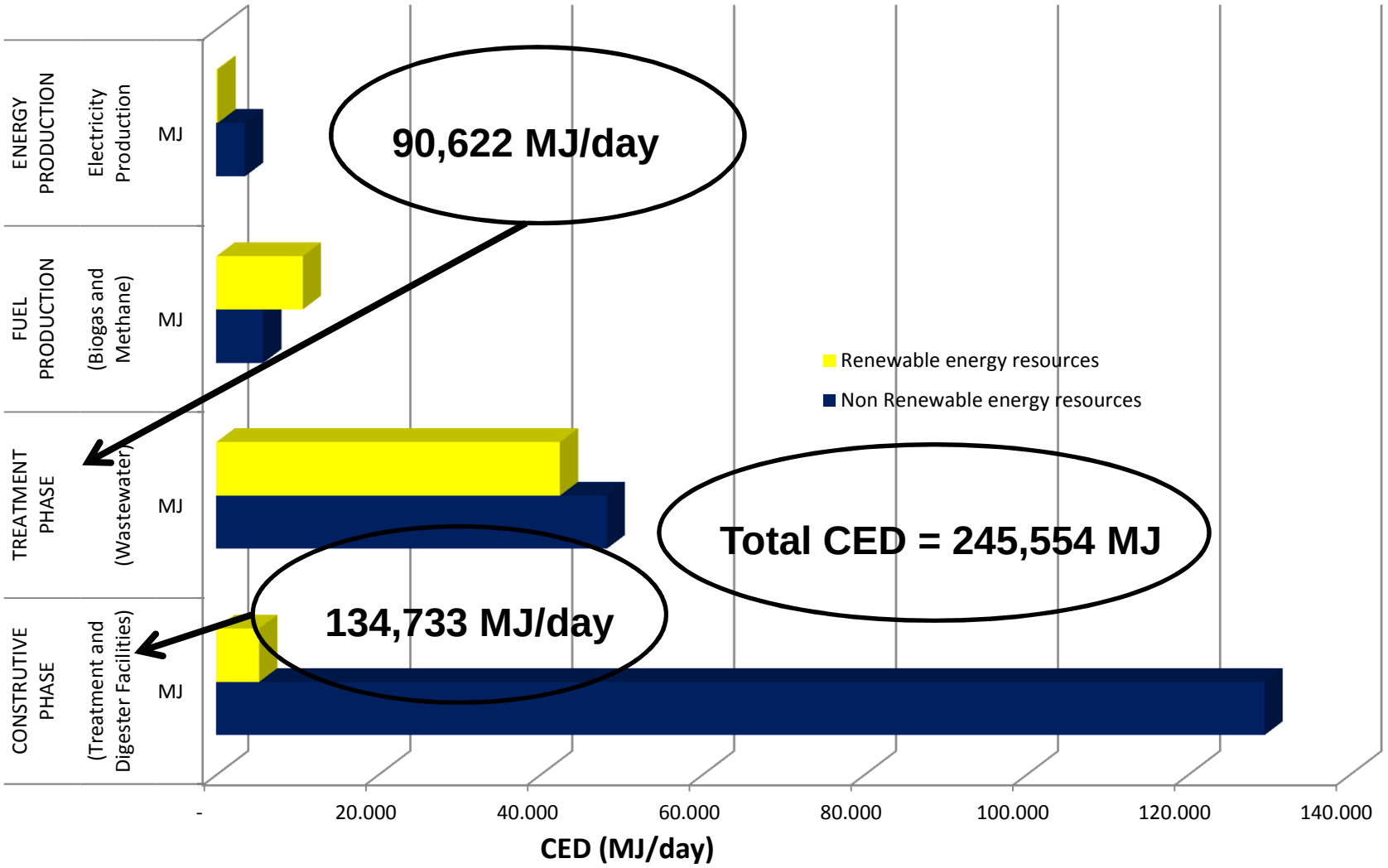
LIFE CYCLE IMPACT ASSESSMENT

- ✓ **Cumulated Energy Demand – CED**
  - Non-renewable resources (hard coal, crude oil, lignite, natural gas and uranium);
  - Renewable resources (biomass, solar energy, wind, hydropower).

- ✓ **Global Warming Potencial**

RESULTS / DISCUSSION

Cumulative Energy Demand



RESULTS / DISCUSSION

Cumulative Energy Demand

	CONSTRUTIVE PHASE		TREATMENT PHASE		FUEL PRODUCTION		ENERGY PRODUCTION		TOTAL	
	(Treatment and Digester Facilities)		(Wastewater)		(Biogas and Methane)		Electricity Production			
	MJ	%	MJ	%	MJ	%	MJ	%	MJ	%
Crude oil	44,387	18.08	9,140	3.72	1,192	0.49	649	0.26	55,368	22.55
Hard Coal	40,883	16.65	11,157	4.54	1,377	0.56	1,072	0.44	54,489	22.19
Lignite	4,480	1.82	4,122	1.68	59	0.02	326	0.13	8,986	3.66
Natural gas	23,640	9.63	11,808	4.81	2,079	0.85	874	0.36	38,401	15.64
Uranium	16,061	6.54	11,958	4.87	1,098	0.45	643	0.26	29,759	12.12
Non Renewable energy resources	129,450	52.72	48,186	19.62	5,804	2.36	3,563	1.45	187,003	76.16

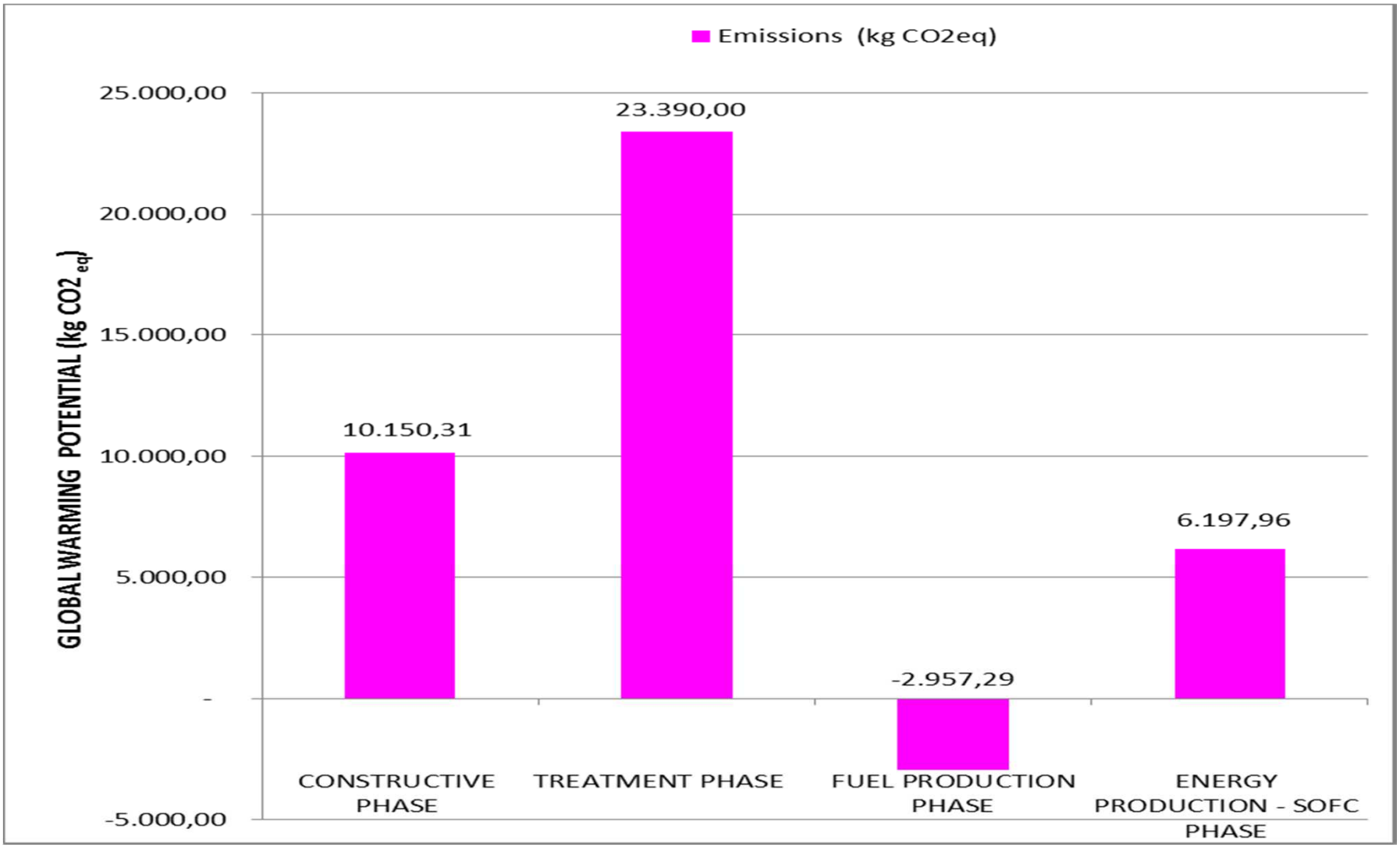
RESULTS / DISCUSSION

Cumulative Energy Demand

	CONSTRUTIVE PHASE		TREATMENT PHASE		FUEL PRODUCTION		ENERGY PRODUCTION		TOTAL	
	(Treatment and Digester Facilities)		(Wastewater)		(Biogas and Methane)		Electricity Production			
	MJ	%	MJ	%	MJ	%	MJ	%	MJ	%
Energy, calorific value, in organic substance	835	0.34	2,458	1.00	620	0.25	40	0.02	3,953	1.61
Energy, gross calorific value, in biomass, primary forest	0	0.00	-	-	0	0.00	0	0.00	0	0.00
Energy, kinetic (in wind), converted	160	0.07	149	0.06	4	0.00	11	0.00	324	0.13
Energy, potential (in hydropower reservoir), converted	4,284	1.74	39,827	16.22	10,040	4.09	117	0.05	54,267	22.10
Energy, solar, converted	1	0.00	2	0.00	0	0.00	0	0.00	4	0.00
Wood	0	0.00	-	-	0	0.00	0	0.00	0	0.00
Material resources	2	0.00	-	-	0	0.00	0	0.00	2	0.00
Renewable energy resources	5,283	2.15	42,436	17.28	10,664	4.34	168	0.07	58,551	23.84
TOTAL ENERGY	134,733	54.87	90,622	36.90	16,469	6.71	3,731	1.52	245,554	100.00

RESULTS / DISCUSSION

Global Warming Potential



CONCLUSIONS

- ✓ **Phase greatest impact in relation to CED: construction of WWTP, depending on the materials used in construction processes**

- ✓ **Use of SOFC shows high efficiency in power generation (use of 88,595 MJ / day of primary energy from biogas produces about 14,000 kWh / day or 50,400 MJ / day)**

- ✓ **Electricity directly (without considering the recovery of thermal energy) is able to meet 100% of the energy demand of the WWTP;**

CONCLUSIONS

- ✓ **Phase greater impact, for GhG, sewage treatment, due to the biodegradation process of organic matter**

- ✓ **Anaerobic digestion process: higher gain in terms of emissions, preventing release of 2,957 kg CO2 eq/day**

- ✓ **Importance of LCA methodology to identify the most unfavorable points in the system**

CONCLUSIONS

- ✓ **The main conclusion achieved shows that is possible to reduce the energy consumption and emissions by using biogas as fuel for fuel cell technology.**

- ✓ **It highlights that the concept of recovery energy from WWTP co-products (biogas) is also associated with the goals of environmental protection and resources conservation.**

- ✓ **Therefore, since the mitigation of impacts is a major function of wastewater treatment systems, then the WWTP should be designed so that the total impacts on the environment are reduced.**

THANK YOU!!!

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