

3rd International Trolleybus Conference

October 23 - 24, 2012 - Leipzig - Germany

**THE BRAZILIAN EXPERIENCE:
ELECTRIFICATION AND RE-ENERGIZING
OF THE
SÃO PAULO METROPOLITAN REGION - SPMR
ABD BUS CORRIDOR**

Project Design, Management and Execution

Eng. Roberto Bartolomeu Berkes

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EMTU - Empresa Metropolitana de Transportes Urbanos

Metropolitan Company of Urban Transports

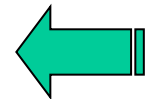
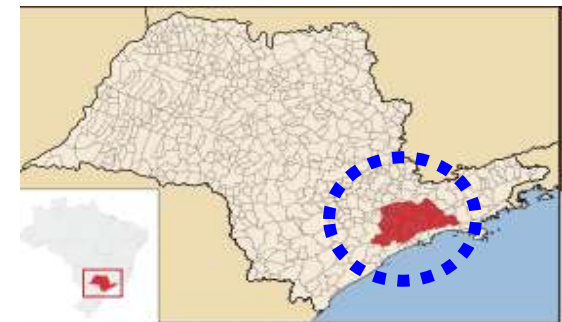
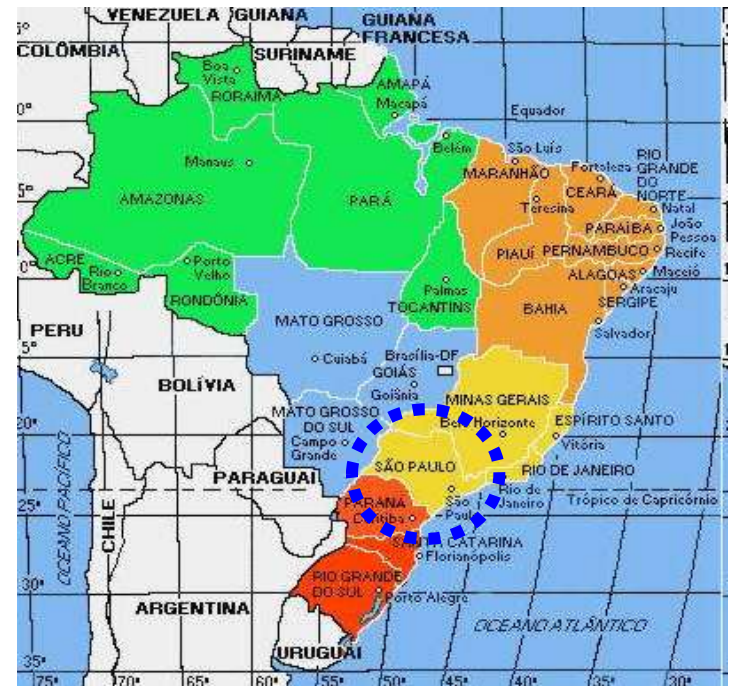
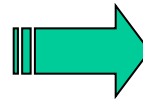
- **Coordination of inter-municipal concessions of public bus lines**
- **Construction, implementation and management of BRT- Bus Rapid Transit corridors**
- **Implementation of electric city bus / trolleybus systems in the São Paulo Metropolitan Region**

RESUME OF THE TROLLEYBUS SYSTEM IN THE SÃO PAULO METROPOLITAN REGION - SPMR





South America – Brazil São Paulo and Metropolitan Region



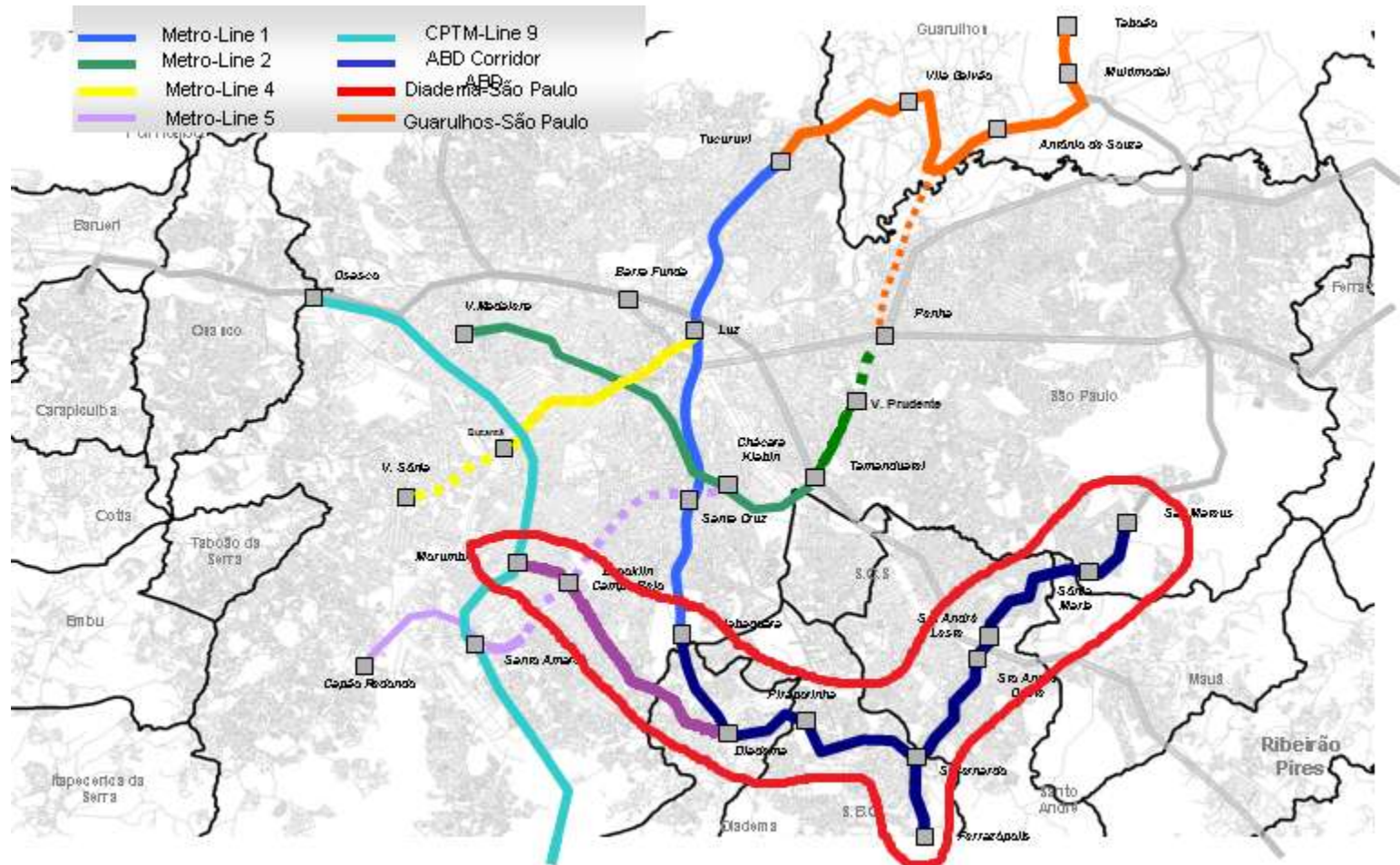
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CITY	MUNICIPALITY	DENSITY POP/KM ²	METRO REGION	DENSITY POP/KM ²
SÃO PAULO				
• Area	1,523 km ²		7,943.8 km ²	
• Population	11,316,149	7,216.3	20 million	2,503.8
LEEDS				
• Area	551.7 km ²		5,700 km ²	
• Population	798,800	1,447.8	2.9 million	530.0
MONTREAL				
• Area	431.5 km ²		4,258.3 km ²	
• Population	1,649,519	4,517.6	3.8 million	898.1
ZURICH				
• Area	88 km ²	4,092	2,103 km ²	951
• Population	390,000		2.0 million	

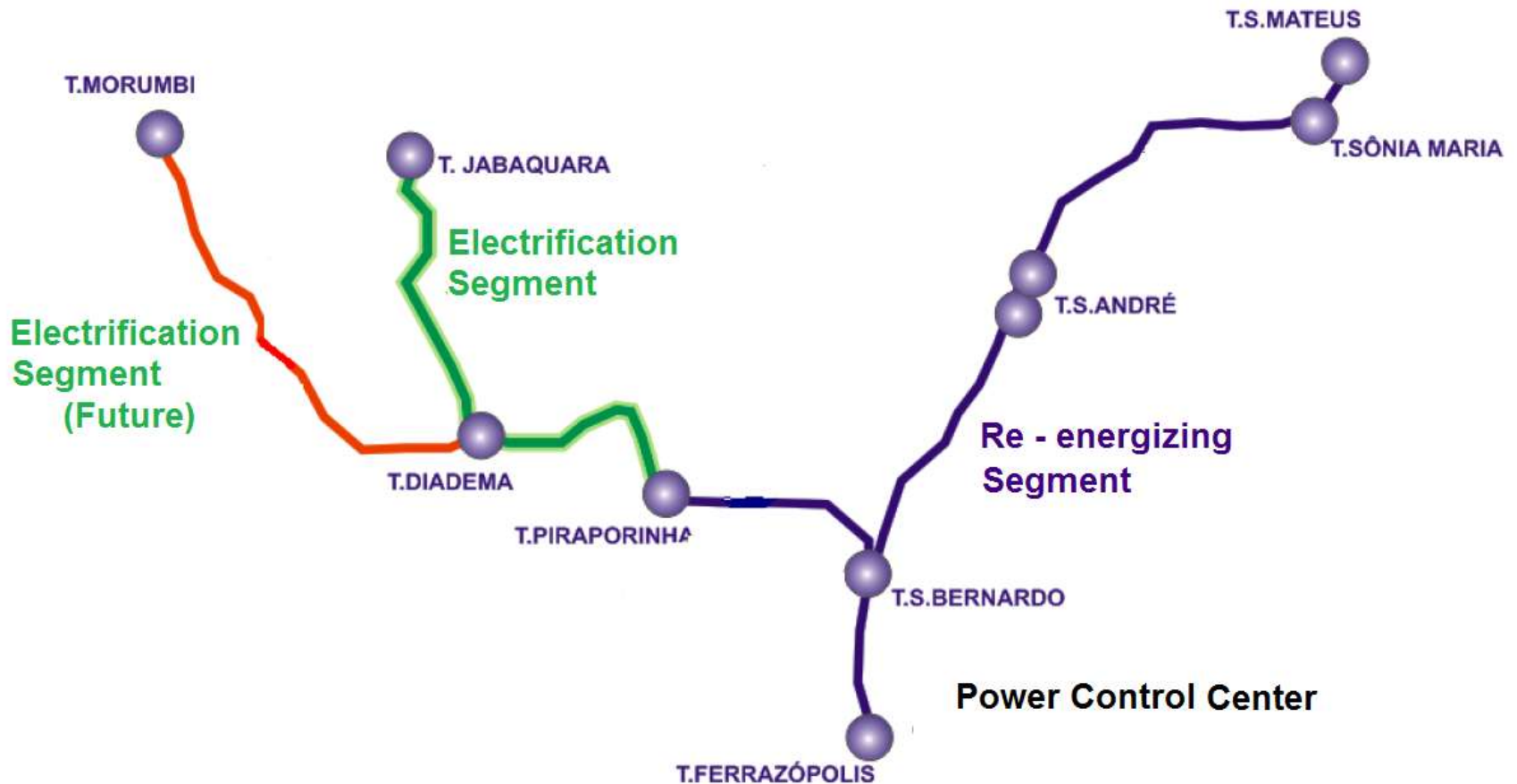
SÃO PAULO METROPOLITAN TRANSPORT MAP

METRO – CPTM (trains)– EMTU (buses) INTERCONNECTION



**SECRETARIA DOS
TRANSPORTES METROPOLITANOS**

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EMTU PROJECT FEATURES:

- **Total Est. Population = + 13 Million** in the municipalities of:
 - Diadema - 388,576
 - Santo André - 678,486
 - São Bernardo - 770,253
 - São Caetano - 149,962
 - São Paulo - 11,316,119
 - Mauá - 421,184
- **Total passengers / day = 275.000 (Jul 12)**
- **Total passengers / month = 7 million (Jul 12)**

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EMTU PROJECT FEATURES (cont):

- 33 km of BRT- Bus Rapid Transit corridor crossing six (6) São Paulo Metro Region municipalities.
- 49 Km of Double Aerial Network
- 50 Rectifier Stations
- Total investment = €\$ 34 Million
- Total diesel fleet replaced: from 70 to 230 electric buses
- Less fuel emissions = Pollution reduction

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PREMISES:

1. STRATEGIC ALIGNMENT WITH THE OBJECTIVES OF THE STATE OF THE SÃO PAULO TROLLEYBUS PROGRAM:

- 1.1. REPLACEMENT OF PETROLEUM PRODUCTS (DIESEL OIL) BY ELECTRIC ENERGY
- 1.2. REDUCTION OF URBAN POLLUTION
- 1.3. IMPROVEMENT OF THE URBAN TRANSPORT SYSTEM
- 1.4. INCENTIVE TO THE NATIONAL INDUSTRY

2. COMPLIANCE WITH CONTRACT OBLIGATIONS IN THE ABD CORRIDOR CONCESSION IN ORDER TO:

- ☐ COMPLETE ELECTRIFICATION
- ☐ GRADUALLY REPLACE THE DIESEL BUS FLEET FOR AN ELECTRIC ONE.

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PREMISES:

1. THE STRATEGIC ALIGNMENT OF THE ELECTRIFICATION OF THE ABD BUS CORRIDOR PROPOSES, AMONG OTHER OBJECTIVES:

1.1. REPLACEMENT OF PETROLEUM PRODUCTS (**DIESEL OIL**)
BY ELECTRIC POWER

1.2. REDUCTION OF URBAN POLLUTION

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INVENTORY OF CO₂ EMISSIONS FROM
FOSSIL FUEL COMBUSTION
IN THE STATE OF SÃO PAULO
1990 - 2008

SECTOR APPROACH
PER TYPE OF FUEL AND ECONOMIC SECTOR
CETESB
JAN 2011

CO2 EMISSIONS FROM FOSSIL FUEL COMBUSTION, IN GgCO₂, PER TYPE OF FUEL AND ECONOMIC SECTOR – STATE OF SÃO PAULO - 1990 TO 2008

CETESB JAN / 2011

TOTAL EMISSIONS PER TYPE AND SECTOR	TOTAL EMISSIONS 2008 GgCO ₂	TOTAL EMISSIONS 2008 %	GROWTH 1990 – 2008 %
TOTAL EMISSIONS	79199	100 %	+ 48 %
TRANSPORT	42710	54 %	+ 80 %
TYPE - DIESEL	28026	35 %	+ 75 %
HIGHWAY TRANSPORT	35171	82 %	+ 83 %
DIESEL IN TRANSPORT	22881	54 %	+ 73 %
DIESEL IN HIGHWAY TRANSPORT	22162	63 %	+ 84 %

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PREMISES:

1. THE STRATEGIC ALIGNMENT OF THE ELECTRIFICATION OF THE ABD BUS CORRIDOR ADDITIONALLY PROPOSES :

1.3. IMPROVEMENT OF THE URBAN TRANSPORT SYSTEM

1.4. INCENTIVE TO THE NATIONAL INDUSTRY :

- ☐ **DEVELOPMENT OF AERIAL AND RECTIFIER EQUIPMENT FOR THE ELECTRIC TRACTION SYSTEM**

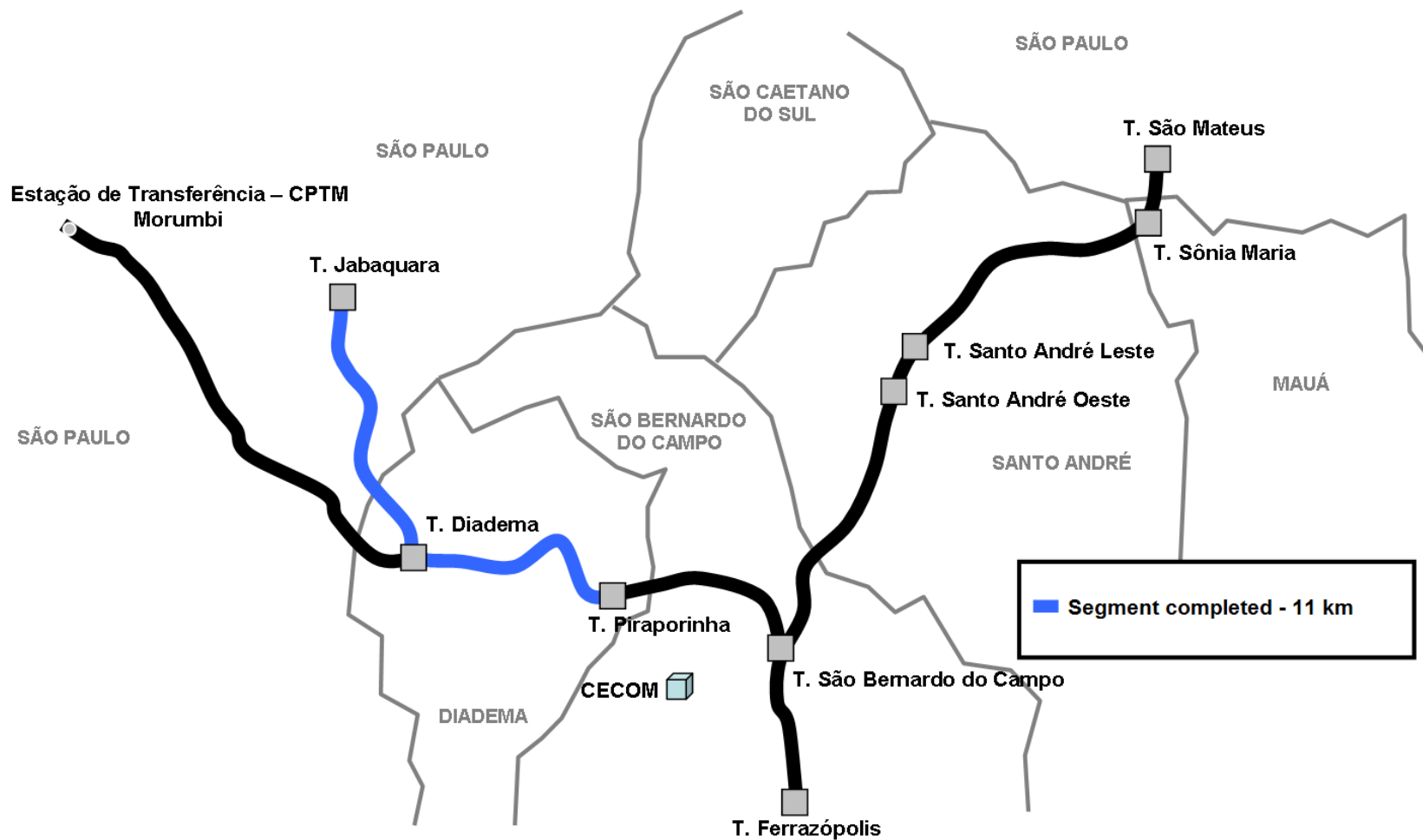
2. COMPLIANCE WITH CONTRACT OBLIGATIONS IN THE ABD CORRIDOR:

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- ☐ ELECTRIFICATION OF THE PIRAPORINHA – JABAQUARA SEGMENT
- ☐ RE-ENERGIZING OF THE PIRAPORINHA - SÃO MATEUS SEGMENT
- ☐ OPERATION AND MAINTENANCE OF THE ELECTRIC TRACTION SYSTEM:
 - ☐ POWER CONTROL CENTER – CCE (SUPERVISION AND CONTROL)
 - ☐ MAINTENANCE OF THE ELECTRIFICATION SYSTEM
- ☐ ELECTRIFICATION OF THE DIADEMA – SÃO PAULO/MORUMBI – EXTENSION (ADDITIONAL)

ELECTRIFICATION OF THE PIRAPORINHA – JABAQUARA SEGMENT



ELECTRIFICATION OF THE PIRAPORINHA – JABAQUARA SEGMENT

PROJECT CHARACTERISTICS

- ❑ 13 RECTIFIER STATIONS - 750 KW.
- ❑ 01 RECTIFIER STATION - 1125 KW (DIADEMA).
- ❑ 11 KM OF DOUBLE AERIAL NETWORK - 650 VCC.

- ❑ INVESTMENT = €\$ 8.6 MILLION

- ❑ START- NOV 30, 2009.
- ❑ TROLLEYBUS OPERATION – MARCH 30, 2011

ELECTRIFICATION OF THE PIRAPORINHA – JABAQUARA SEGMENT

PHOTOS – AERIAL NETWORK

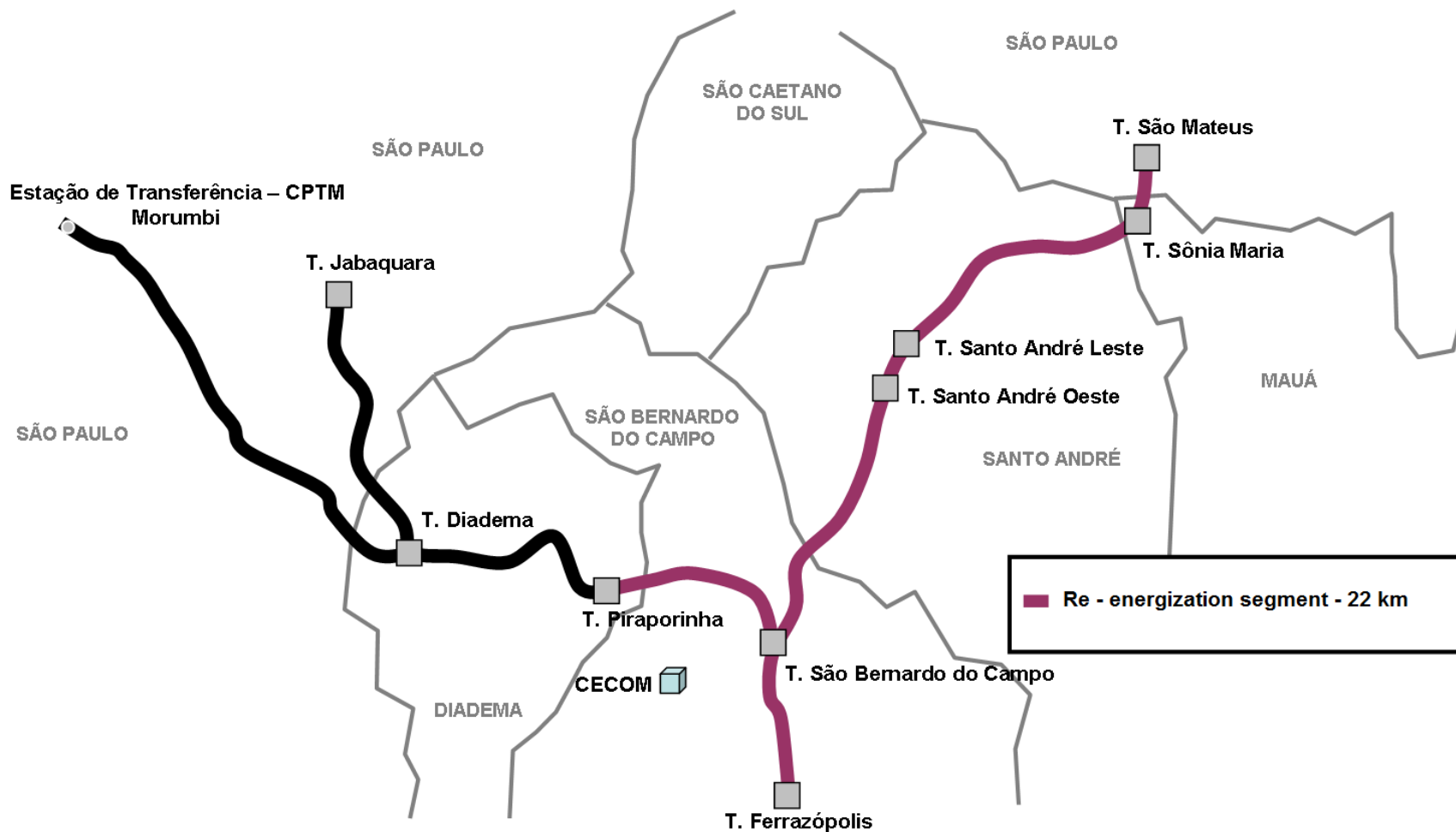


ELECTRIFICATION OF THE PIRAPORINHA – JABAQUARA SEGMENT

PHOTOS – RECTIFIER STATIONS



RE-ENERGIZING OF THE PIRAPORINHA - SÃO MATEUS SEGMENT



RE-ENERGIZING OF THE PIRAPORINHA - SÃO MATEUS SEGMENT

PROJECT CHARACTERISTICS

- ❑ 1 KM OF NEW AERIAL NETWORK AT THE SONIA MARIA TERMINAL
- ❑ EXPANSION - 13 CONCRETE FOUNDATIONS AT THE EXISTING STATIONS
- ❑ CONSTRUCTION - 15 NEW CONCRETE FOUNDATIONS

- ❑ REMOVAL AND REPLACEMENT OF THE 13 EXISTING STATIONS (500 KW) WHICH MAY BE UTILIZED IN THE ELECTRIFICATION OF THE DIADEMA – MORUMBI EXTENSION

- ❑ 28 NEW RECTIFIER STATIONS:
 - ❑ 01 - 1500 KW
 - ❑ 21 - 1000 KW
 - ❑ 06 - 750 KW

- ❑ INVESTMENT = €\$ 11.1 MILLION
- ❑ START – DECEMBER 1 , 2011
- ❑ COMPLETION – JULY 2013

RE-ENERGIZING OF THE PIRAPORINHA - SÃO MATEUS SEGMENT

PHOTOS – EXISTING RECTIFIER STATIONS



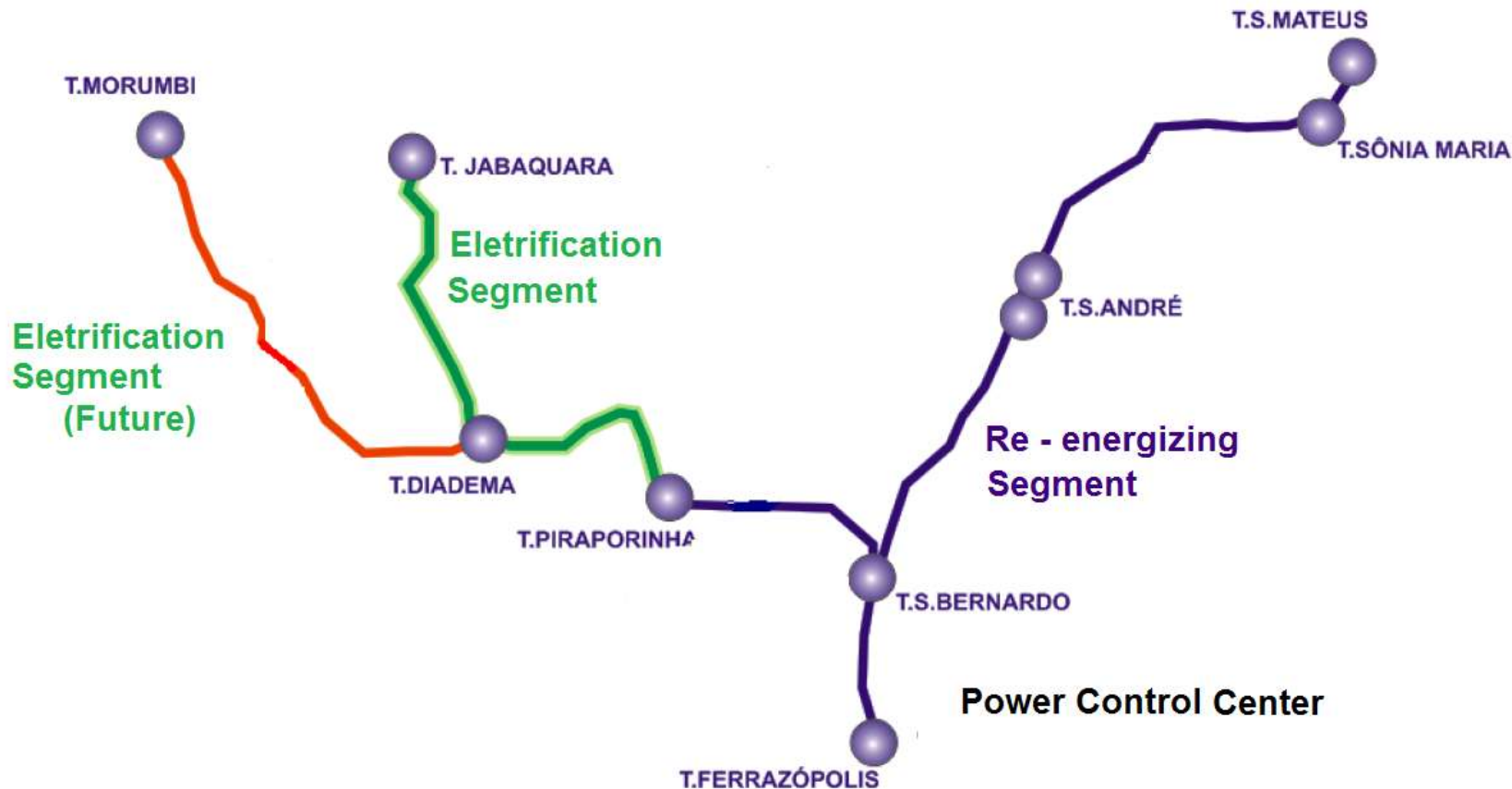
RE-ENERGIZING OF THE PIRAPORINHA - SÃO MATEUS SEGMENT

PHOTOS – RECTIFIER STATIONS UNDER CONSTRUCTION



OPERATION AND MAINTENANCE OF THE ELECTRIC SYSTEM

POWER CONTROL CENTER – CCE



OPERATION AND MAINTENANCE OF THE ELECTRIC SYSTEM POWER CONTROL CENTER – CCE PROJECT CHARACTERISTICS

☐ SUPERVISION AND CONTROL SYSTEM:

- ☐ 50 RECTIFIER STATIONS
- ☐ 49 KM OF AERIAL NETWORK
- ☐ REMODELING OF POWER CONTROL CENTER LOCATION
- ☐ FIBER OPTIC ALONG THE CORRIDOR
- ☐ PLCS - PROGRAMMABLE LOGIC CONTROLLERS- IN ALL RECTIFIER STATIONS.

☐ INVESTMENT - €\$ 4.3 MILLION.

☐ RELEVANT DATA:

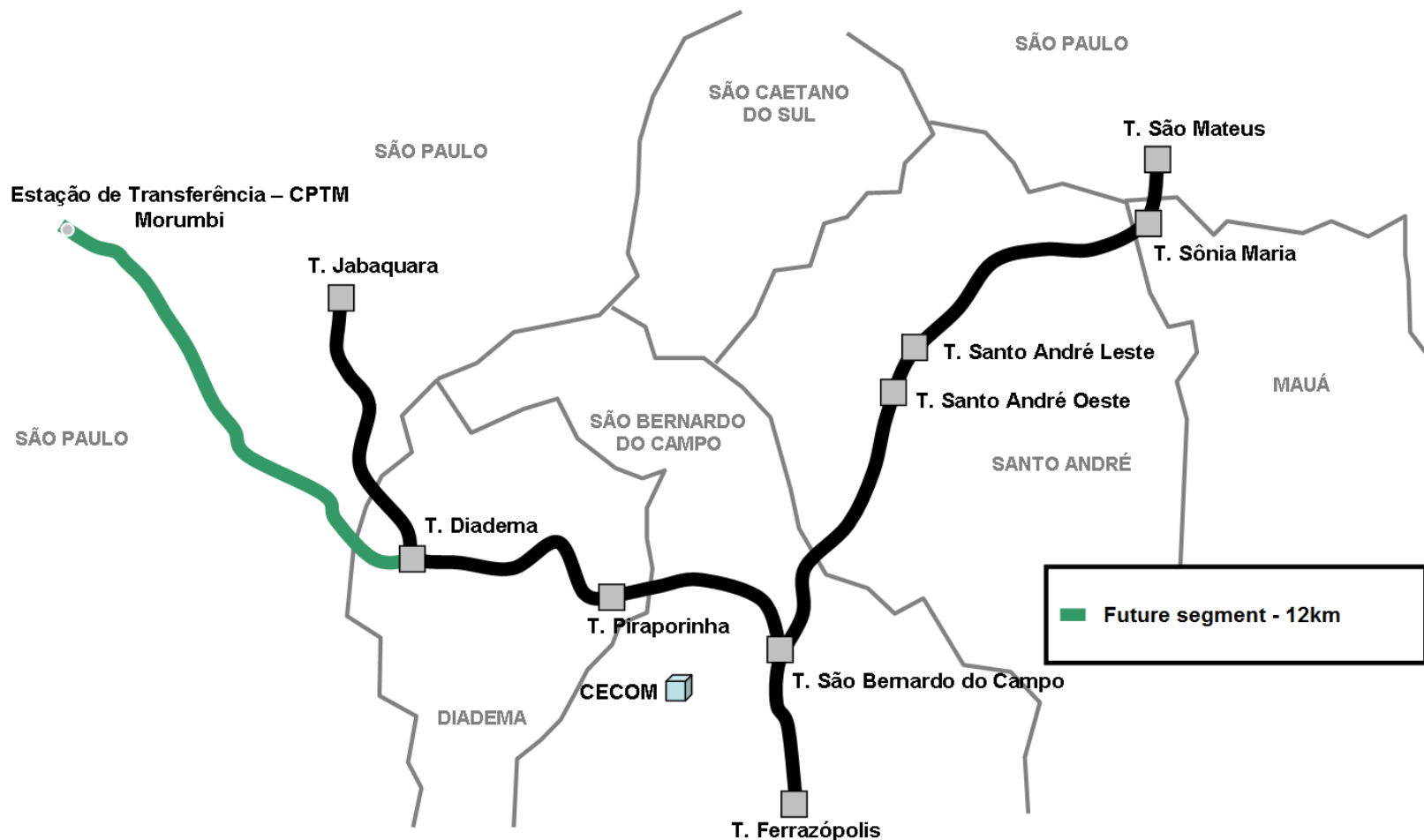
CCTV, PUBLIC ADDRESS IMAGE AND VOICE SYSTEM AT BUS STOPS

OPERATION AND MAINTENANCE OF THE ELECTRIC SYSTEM

MAINTENANCE OF THE ELECTRIFICATION SYSTEM

- ☐ **PREVENTIVE AND CORRECTION MAINTENANCE OF THE EXISTING AND NEW ELECTRIFICATION SYSTEM**
- ☐ **RELEVANT DATA: PERFORMED BY THE BUS SERVICE CONCESSIONAIRE**

ELECTRIFICATION OF THE DIADEMA – SÃO PAULO (MORUMBI) EXTENSION



ELECTRIFICATION OF THE DIADEMA – SÃO PAULO (MORUMBI) EXTENSION

PROJECT CHARACTERISTICS

- ❑ 12 KM OF NEW AERIAL NETWORK (POWER POLES AND TRACTION NETWORK).
- ❑ 8 RECTIFIER STATIONS – (500 KW) MAY BE INSTALLED AFTER BEING REFURBISHED, ORIGINATING FROM THE SÃO MATEUS – PIRAPORINHA SEGMENT.
- ❑ INVESTMENT = €\$ 10.1 MILLION.
- ❑ RELEVANT DATA: NEW TECHNOLOGY UNDER STUDY: SUPERCAPS, TRANSFER OF INDUCTIVE LOAD AND OTHERS

ELECTRIFICATION OF THE DIADEMA – SÃO PAULO (MORUMBI) EXTENSION

PHOTOS – CORRIDOR



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