

Green Solutions for Public Transport In Cluj-Napoca



TRAM

Best practices in green transport and low carbon
emissions

Karlsrona, Sweden, 8 - 9 March , 2017

Cluj-Napoca Romania in 2017
We need mobility, we need clean air .
The solution is electric transport .



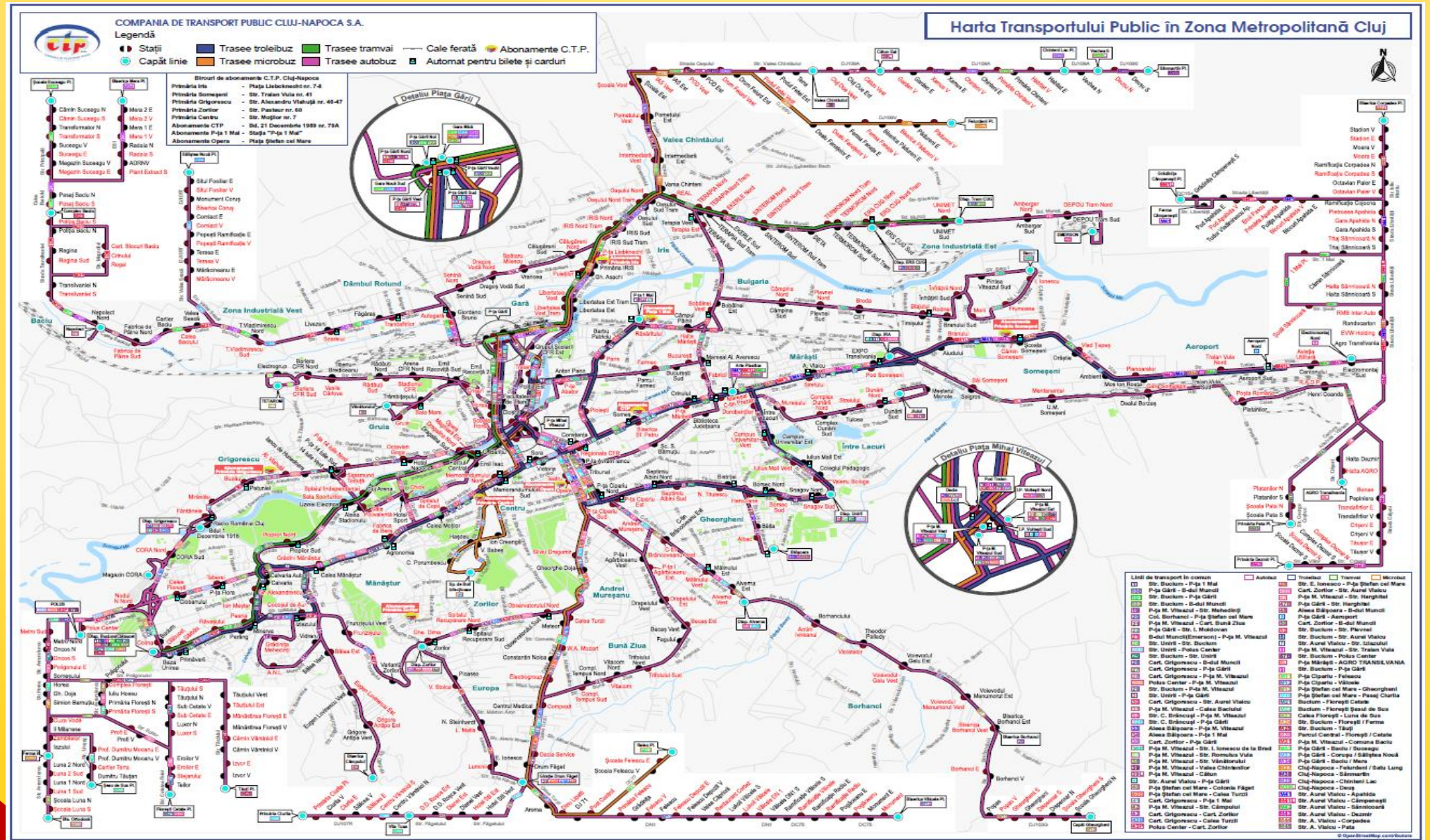


Cluj-Napoca

one of the largest cities in Romania

- Has a population of over 400 000 (four hundred thousands) inhabitants
- Area 180 (one hundred and eighty) square kilometers
- An important center
- More than 100 000 (one hundred thousands) students in seven universities
 - residential
 - economic
 - cultural

Public transport network in the city of Cluj-Napoca



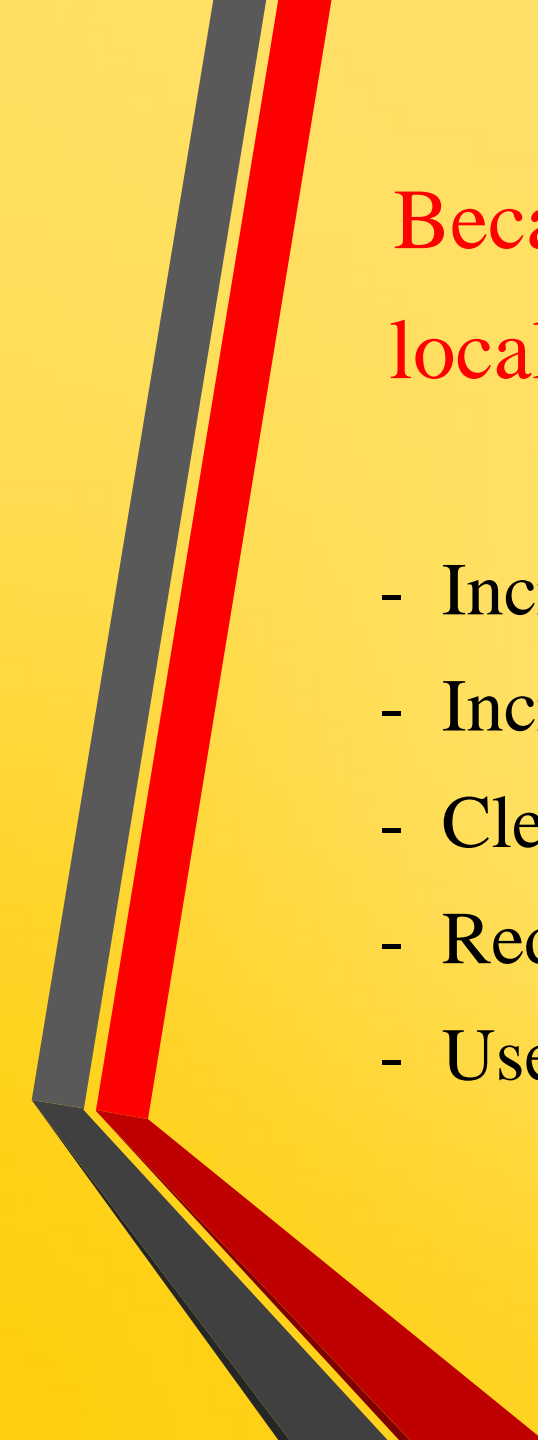
NEED FOR MOBILITY

Public passengers transport

- Very important social service, vital for city
- Provide the movement to
 - work
 - school
 - shopping
 - culture
 - Recreation, tourism
- A problem to be solved by local authorities

Public transport - Spine mobility

- Mobility role
- Used by a large number of people
- Access for all people
- Decongests traffic
- A public vehicle replaces 20 cars
 - Reduce environmental pollution 5 times / traveler.
 - Reduce energy consumption by 5 times.
 - It is more economical (cheaper) 5 times.
 - It is 20 times safer.
 - For ELECTRIC TRANSPORT these features are far superior.



Because of the importance of public transport
local authorities and CTP Cluj-Napoca follow

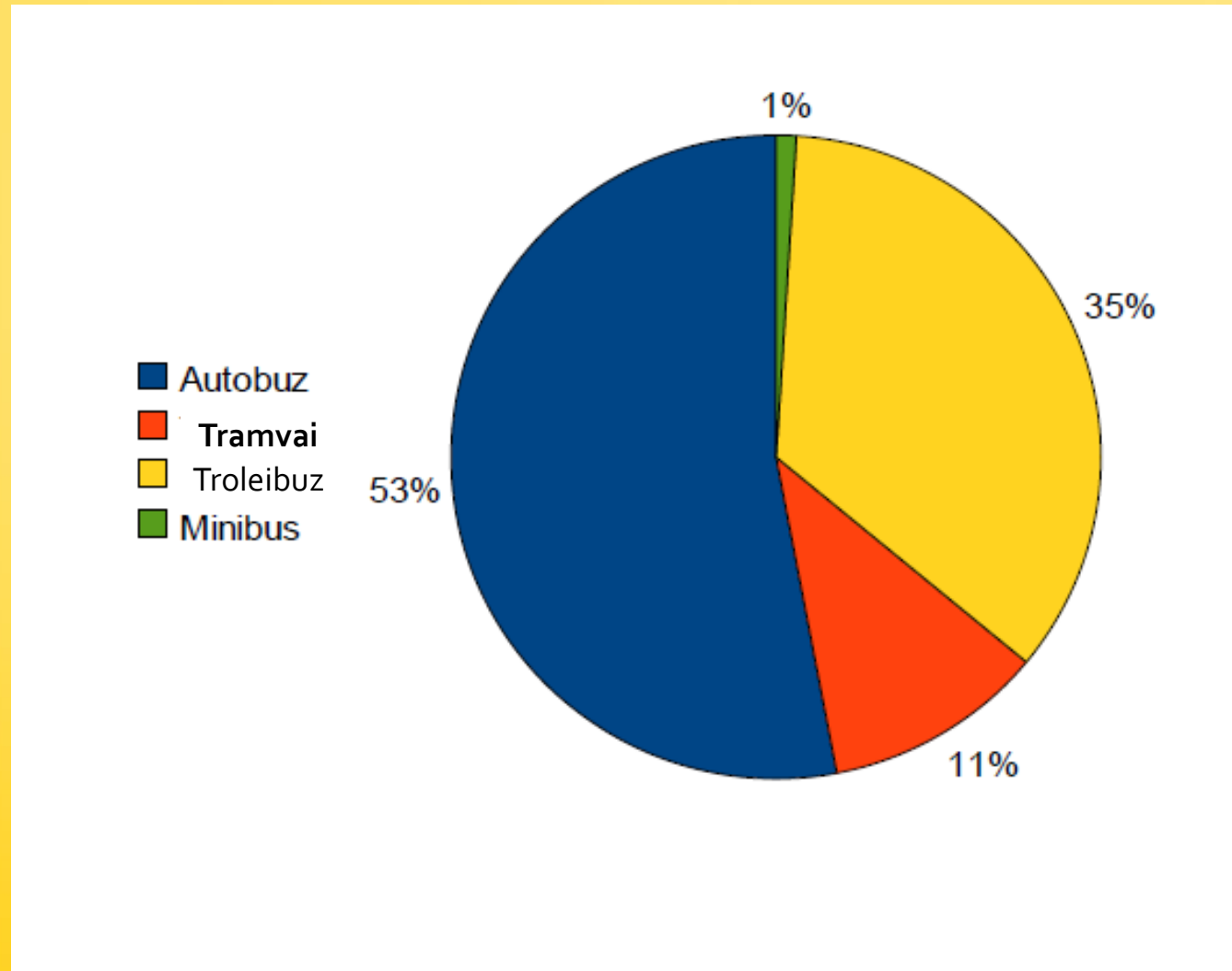
- Increasing efficiency, quality, comfort, safety
- Increasing the number of passengers
- Clean and friendly environment
- Reducing energy consumption
- Use of renewable energy



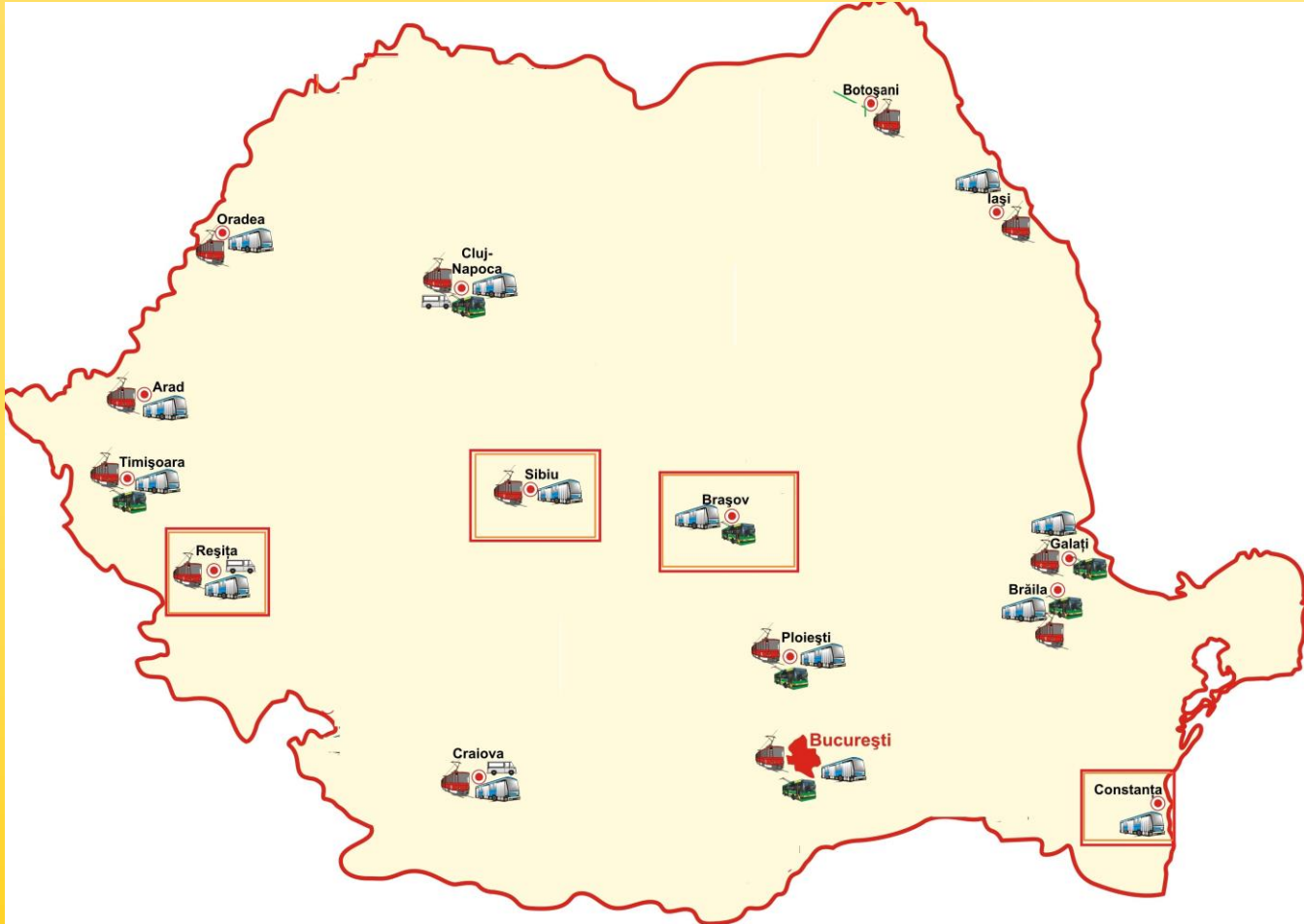
Public Passenger Transport in
Cluj-Napoca and the Metropolitan Area
it is provided by
Public Transport Company SA Cluj-Napoca

- very important social activity done with
 - diesel buses - 227 pcs
 - trolleybuses - 91 pcs
 - trams - 38 pcs
- it recorded a total of 180 million trips per year
(approximate 500, 000 trips per day)

Different means of public transport in Cluj-Napoca Year 2016



The cities with tram in Romania



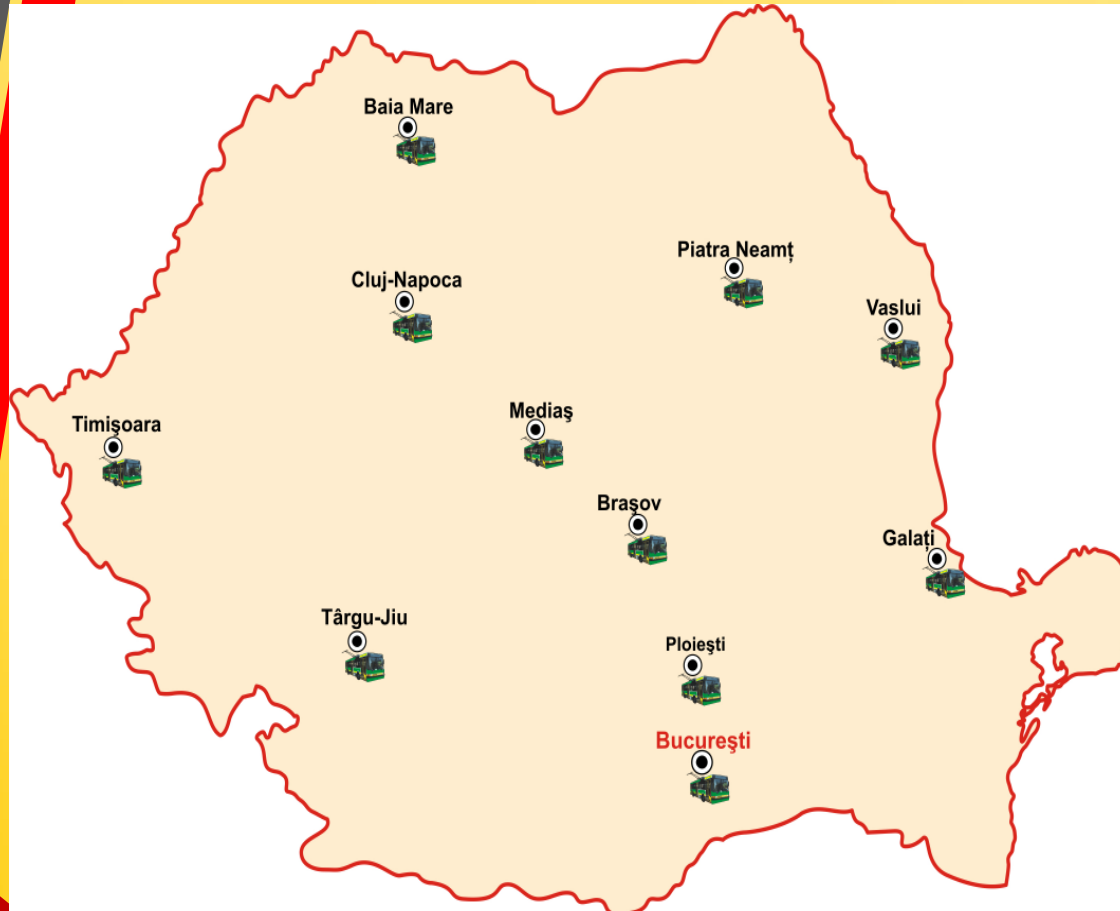
Cities with tram



Cities who give up the trams

- Brasov
- Sibiu
- Resita
- Constanta

Cities with trolleybus line in Romania



11 Cities with trolleybus 7 Cities who gave up trolleybus

Baia Mare

Brasov

Bucuresti

Cluj-Napoca

Galati

Medias

Piatra Neamt

Ploiesti

Targu Jiu

Timisoara

Vaslui

Braila

Constanta

Iasi

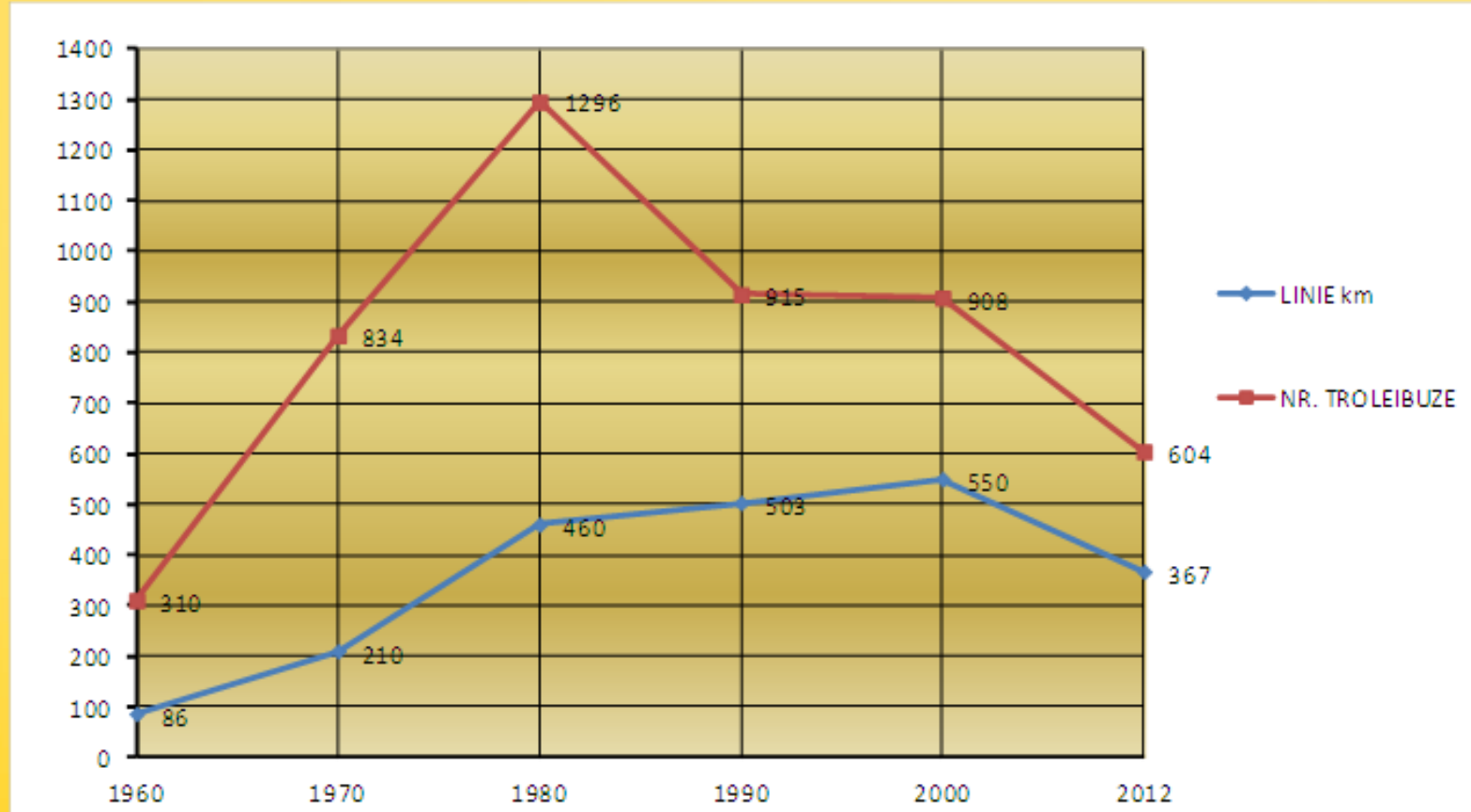
Satu Mare

Sibiu

Slatina

Suceava

Evolution of the number of trolleys and catenary in Romania



Advantages of electric transport

- - Completely clean
- - Efficient energy consumption
 - 2.5-3 times lower than diesel buses
 - 4 times lower for tram
- - Yield of 90% as compared to 30-35% for diesel engine
- - Electric energy - easily obtained from renewable resources (solar, wind, hydro, etc.)
- - Recovers braking energy, approximately 30% of the total energy absorbed
- - The engine does not work when the vehicle is stopped
- - Electric brake – more efficient
- - Quiet , low vibration and low noise pollution

15 diesel buses were converted in trolleybuses – 2011

- Increase energy efficiency
- Ecological
- Modern facilities
- Half the price of a new trolley
- Operation successful nationally and internationally acclaimed
- Award AGIR (General Association of Engineers in Romania) 2011

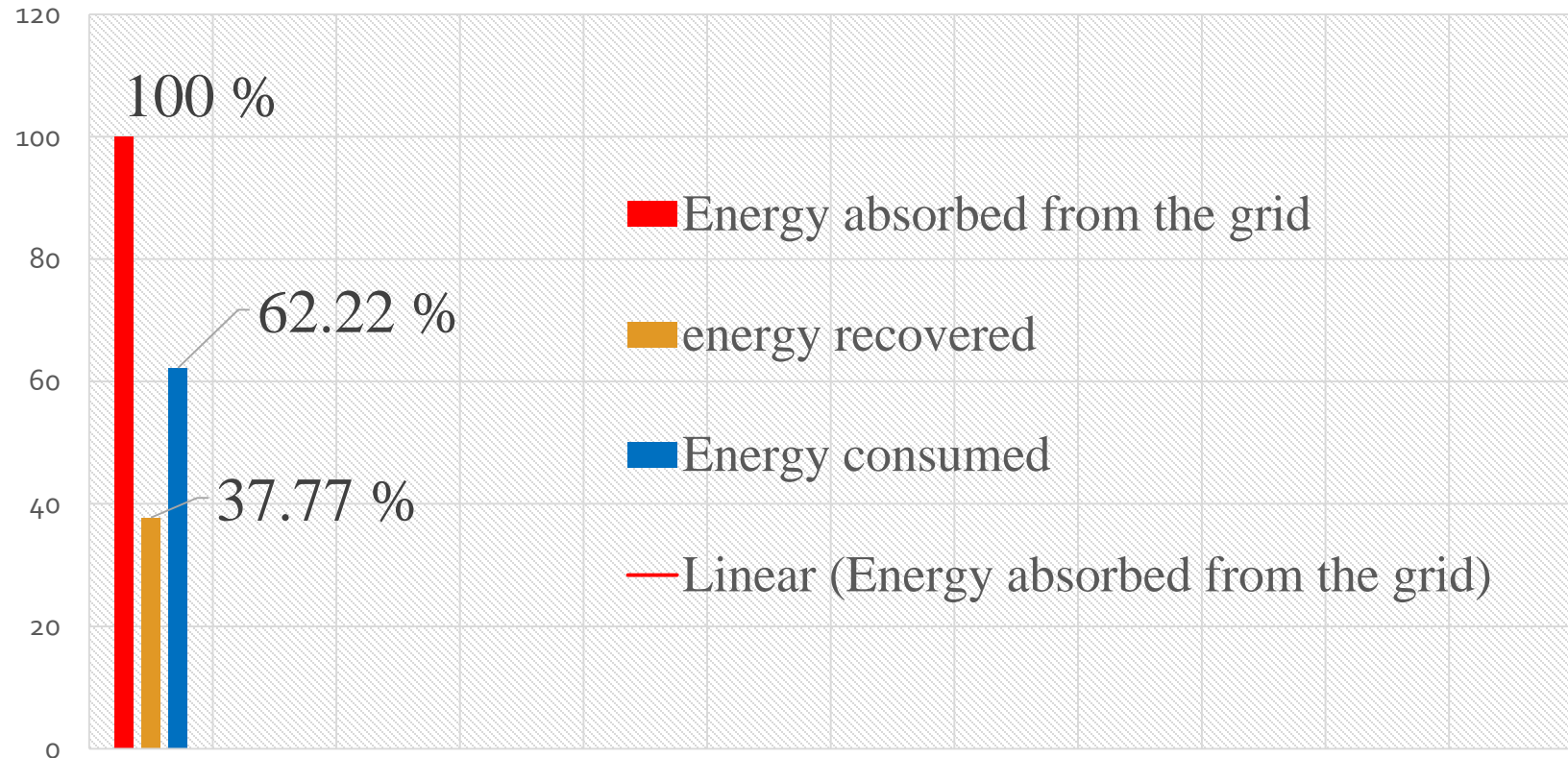


Articulated trolleybus obtained by modifying a diesel bus.

Circuit measurements for converted articulated trolley

Nr	Masuratori (Interstatii)	Distant a m	Nr frinari	Franari/ Km	Durata unei frantar	Viteza medie Km/h	Energie abs din retea kwh	Energie recup. Kwh	energie recuper ata %
1	Clabucet-Cimpului	2300	15	6,52	6-8s	35	3	2	
2	Cimpului-Agronomia	700	1	1,4	20s	35	1	1	
3	Agronomia Sp.Copii	600	3	5	5-8s	25	1	0	
4	Sp. Copii-Memorand	700	3	4,3	4-6s	20	1	1	
5	Memorand-Somesul	1600	15	9,4	6s	25-30	3	1	
6	Somesul-Colegiul Ped	2500	20	8	7-9s	25	4	2	
7	Colegiul Ped-Titulesc	1400	7	5	5-7s	25	4	1	
8	Titulescu-P.Avram I.	1800	12	6,6	8s	30	2	1	
9	Pta Avr lancu-Sp Cop.	1600	16	10	6-8s	20	3	1	
10	Sp.Cop.-Cimpului	1400	10	7,15	6s	25-30	3	1	
11	Cimpului -Clabucet	1900	8	4,2	6-8s	25	5	0	
	Bucla int. Clabucet	500							
12	Clabucet-Minerva	700	3	4,3	10-12s	25	2	1	
13	Minerva-Cimpului	1600	11	6,8	7-9s	25	2	1	
14	Cimp-Memorandum	2900	15	5,2	10s	25	2	1	
15	Memorandum-Somes	1600	9	5,6	8-10s	30	5	2	
16	Somes-Colegiu Ped.	2500	16	6,4	7-9s	25	4	1	
	TOTAL	25800	164	6,35			45	17	37,8%

Energy balance for a trolley with inverter and induction motor



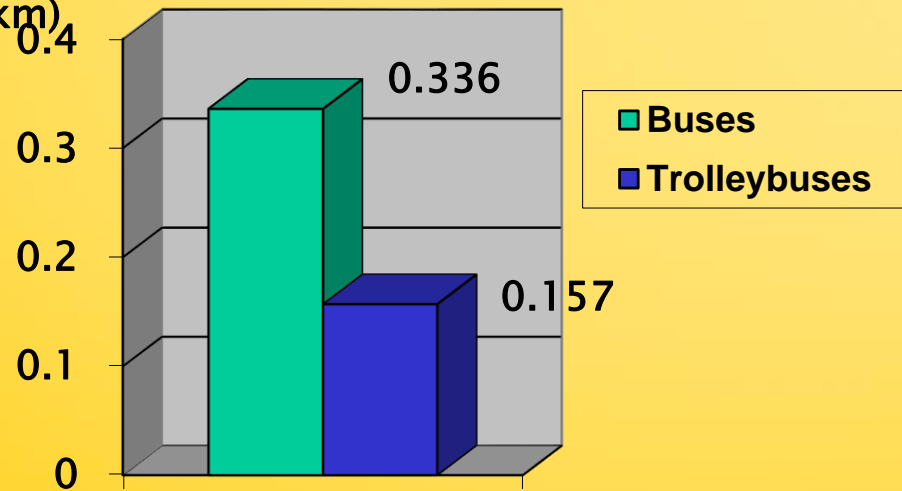
Comparative consumption and costs 5 articulated diesel buses and 5 trolleybuses converted from diesel buses

- The present data include the period January 1 2012 to July 31, 2012 (7 months)
- Trolleybuses electricity consumption cost
1,8249Kwh /Km=0.157tep/km 0,121Euro / Km
- Diesel buses consumption cost
0.4 l / Km=0.336tep/km 0.374 Euro / Km
- Value ratio is in favor of trolleybus
- Braking energy is recovered 37.8% of the absorbed energy.
- Total consumption of diesel buses in the specified 5 was 109 652 liters (92 650 kg).
- The total quantity of pollutants emitted by 5 diesel buses was 303.4 tonnes in 7 months
- The 15 trolley buses converted from diesel , annually reduced pollution with 1560 tonnes.

Comparative consumption and costs between buses and trolleybuses

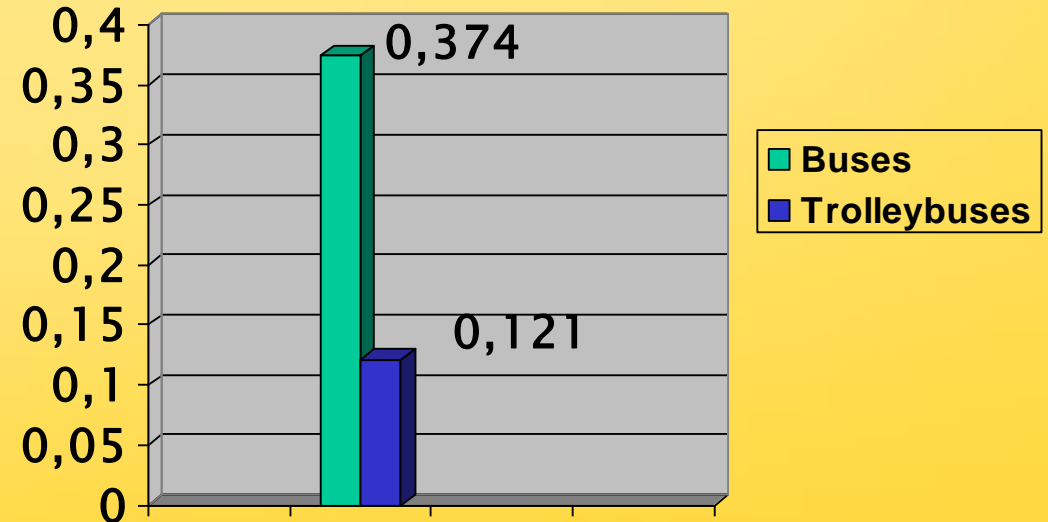
Fuel consumption

Fuel consumption (kg e.p./km)



Energy cost

Cost (Euro/km)



The calculation of emissions of pollutants
FOR BUSES WITH DIESEL ENGINE

5 diesel buses in the period January 1st 2012 until July 31, 2012 (7 months)

Nr. crt.	consum diesel tone	Tip pollutant	Factor de emissions Kg / to	quantity emissions Kg	quantity emissions tone	quantity emissions	quantity emissions
						annual tone	15 buses annual
1	92,65	CO2 (carbon dioxide)	3183	294904,95	294,90	505,55	1516,65
2		CO (carbon monoxide)	34,2	3168,63	3,17	5,43	16,30
3		CH4 (methane)	0,25	23,16	0,02	0,04	0,12
4		N2O (nitrous oxide)	0,12	11,12	0,01	0,02	0,06
5		PS (particulate matter)	4,3	398,40	0,40	0,68	2,05
6		NO (Nitrogen oxide)	42,7	3956,16	3,96	6,78	20,35
7		SO2 (Sulf dioxide)	10	926,50	0,93	1,59	4,76
8		Cd (cadmium)	0,00001	0,00093	0,00	0,00	0,00
			TOTAL	303389	303,4	520,10	1560

Cluj-Napoca maintain and develop electric transport

- 14 trams were upgraded by choppers (2005-2007)
the yield increased by 50-60%
- Acquisition of new electric vehicles, comfortable performance, with braking energy recove
 - Trolley - 27 pcs. chopper (2004-2006)
 - 48 pcs. induction motor with inverter (2010-2016)
 - Trams - 4 pcs. with inverter and induction motor (2012)

Trolleybuses in Cluj-Napoca



Trolley Astra - Irisbus Citelis



Iveco Astra-Town Trolley

Trams in Cluj-Napoca



KT4D from Berlin



KT4DM from Postdam



SWING PESA POLONIA

Year 2005 - Alternatives for demolition or modernization of the tram line

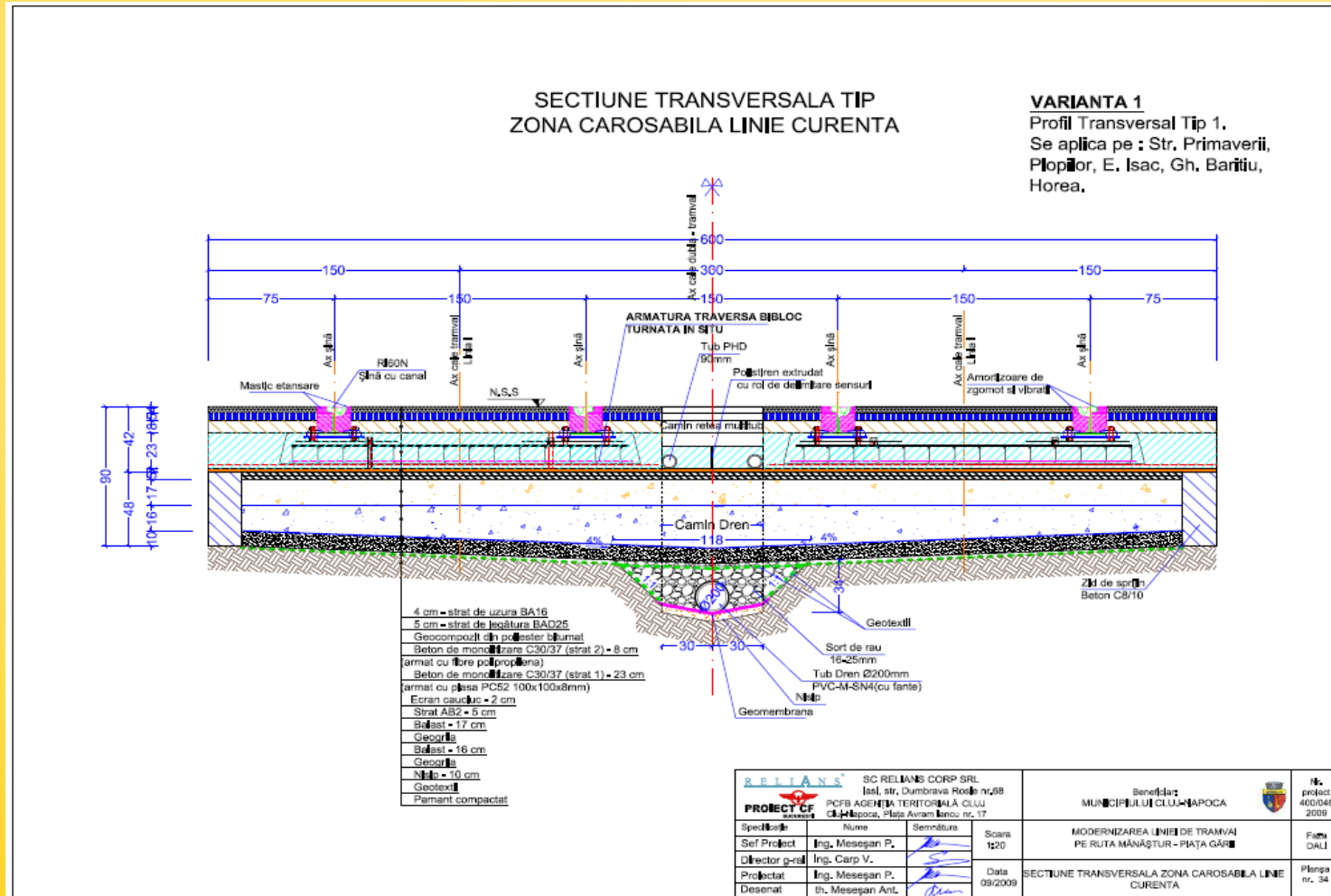
- Old line in 2010 - very degraded
 - Danger to traffic safety
- - The chosen solution - modernization of the tram line



Modernisation of the tram is the most important work in recent years

- Period - 2011 - 2013
- Length - 26 Km simple line
- Funds - European and local budget
- Cost - EUR 34 million
- Technology - modern, very low noise

The new line tramways project - Cross section




Phase of project execution



New trams running on upgraded lines





Procurement procedures in progress for new electric vehicles

- 10 electric buses that will replace 10 diesel buses
length of 12 m and 70 km autonomy
- 8 articulated buses with a length of 18 m
- 6 trams length of 30 m



10 ELECTRIC BUSES THE FIRST in ROMANIA and Cluj-Napoca

- We started replacing diesel buses with electric buses
- The tender procedure was started
- In 2017 in Cluj-Napoca will operate 10 electric buses
- By replacing 10 diesel buses by 10 electric buses
reduces harmful emissions by 545.7 tons per year
- We breathe cleaner air, we will be healthier
- Diesel buses replacement program will continue

The calculation of emissions of pollutants
FOR BUSES WITH DIESEL ENGINE

One bus diesel consumption of 28 liters / 100 km and traveling 160 km / day

Nr. crt.	consumption diesel	Type pollutant	factor pollutant	quantity emissions	quantity emissions	quantity emissions	quantity emissions
	tone / month		Kg / to	Kg / month	tone/month	tone / year	10 buses tone / Year
1	1,39	CO2 (carbon dioxide)	3183	4420,55	4,42	53,05	530,47
2		CO (carbon monoxide)	34,2	47,50	0,05	0,57	5,70
3		CH4 (methane)	0,25	0,35	0,00	0,00	0,04
4		N2O (nitrous oxide)	0,12	0,17	0,00	0,00	0,02
5		PS (particulate matter)	4,3	5,97	0,01	0,07	0,72
6		NO (Nitrogen oxide)	42,7	59,30	0,06	0,71	7,12
7		SO2 (Sulf dioxide)	10	13,89	0,01	0,17	1,67
8		Cd (cadmium)	0,00001	0,00001	0,00	0,00	0,00
			TOTAL	4548	4,5	54,57	545,7

Plans and strategies for the development of electric transport

CTP and local authorities were involved in developing sustainable city development plans.

- Sustainable Urban Mobility Plan PMUD
- SIDU pebntru Integrated Urban Development Strategy
- SEAP Sustainable Energy Action Plan
- CTP proposed and supported especially in public transport projects and energetic approach.

Projects proposed short-term (2017-2020)

- The acquisition of 10 new , modern trams .
- The acquisition of 20 new , modern trolleybuses
- Acquisition of 20 electric buses.
- Modernization of the tram depot.

Projects for the next stage (2020-2030)

- Extending the tram line in suburban area (8 km double track)
- Extension of the trolley transport in city (three new tracks)
- Upgrading trolley power line
- Upgrading tram power line
- Building a power station for the trolley line
- Construction of electric power stations with photovoltaic panels for electric traction.

Projects to improve mobility and public transport

- Modification or establishment of new routes
- The establishment of dedicated lanes for public transport
- IT project for general traffic management in the city
- Prioritizing public transport intersections (green lights)

European documents that promote green transport

- **The Project UITP PT X2**
 - 2025 to double the number of passengers using public transport.
- **Transport White Paper (28 March 2011).**
 - up to 2050 be removed from cars cities using fossil fuels (until 2030 half)
- **Action plan for urban mobility (2009)**
- **The strategy "Europe 2020" - program 20-20-20**
 - 20% -reducing gas emissions greenhouse
 - 20% reduction in final energy consumption
 - increasing to min 20% the share of renewables energy consumed
- **Energy Efficiency Directive (2012/27 / EU) states:**
 - To promote renewable energy sources
 - Energy efficient public procurement

Documents national (Romanian) promoting green transportation

- Romania-EU Partnership - 2014-2020
- Law Nr. 919/2002 public transport operators to purchase adapted vehicles for unrestricted access to people with motor disabilities.
- 2014-2020 National Action Plan on climate change,
 - use renewable energy,
 - encrease energy efficiency
 - environmental protection
- OUG 40/2011 which transposes into Romanian legislation DE33 / 2009. Clean Fleet
- Law Nr. 69/2016 on green public procurement.

Electric transport satisfied all these requirements

Solutions for GREEN Public Transport in Cluj-Napoca

- Modernize the fleet of trolleys and trams
with new, comfortable, economical and quiet
- Reducing energy consumption
- Replacing diesel buses with electric buses

ELECTRIC TRANSPORTATION IS A GREEN TRANSPORT
SOLUTION IS ELECTRIC TRANSPORT



Thank you for your time .

Dr. Ing. Liviu Neag -President URTP
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