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FACULTY OF ENGINEERING

SZEGEDI KÖZLEKEDÉSI TÁRSASÁG

Increasing the quality of Public Transport: modern infrastructure and vehicles

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21.03.2013. Sibiu

trolley
Promoting electric public transport

CENTRAL EUROPE
COOPERATING FOR SUCCESS.

- First, briefly I'll show some elements of our new infrastructure developments.
- Next, very shortly about the new vehicles.
- About the reality, the Players and their Expectations, the aspects of the quality of Public Transport.
- The real data of Szeged public transport.
- Numerology, statements, conclusions and questions, questions, questions.

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New technology: Siemens SITRAS rectifier modern equipment

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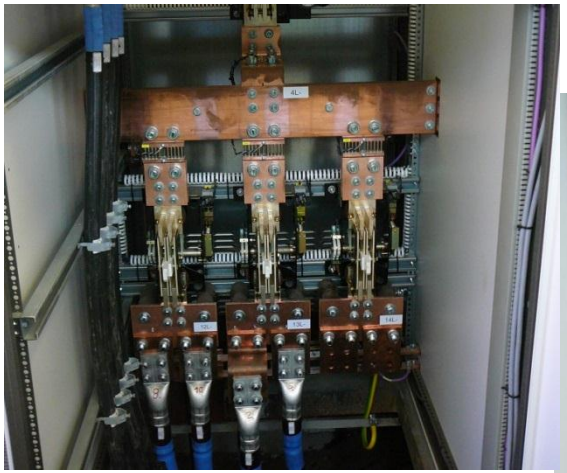
Positive experience:
The device working normally.



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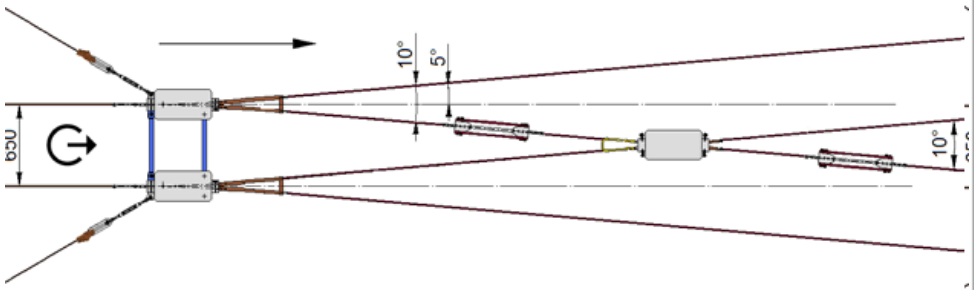
New technology:

- TB electric transmission
- TB mechanic transmission



Positive experiences:

- The equipments allows higher cross speed (30-50 km/h)
- The maintenance minimized (cleaning and lubrication)
- The life time of the wearing parts 3-4 years (depending on the traffic)

Negative experiences:

The radio-frequency power converter in freeware frequency band (433.5 to 434.79 MHz), this can cause imbalance in the remote control.

RAFS track

New technology: Flexible based, continuous bearing rail design

Positive experiences:

- The noise and vibration levels, according to plan, lower than the previous rail design without insulated bearing
- No need to regulate the tracks, panels or stone cladding yet

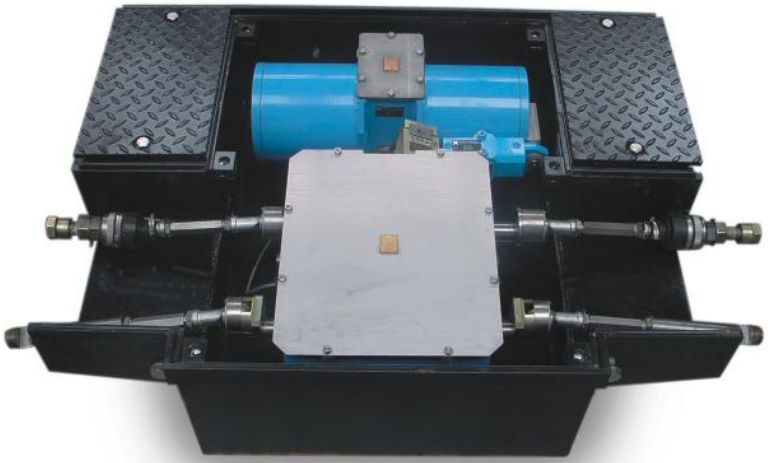
Negative experiences:

The poor construction quality and the high axle load transport caused failures (shell cracks, potholes by the track)

Electric drived switch with radio-frequency control unit

New technology:

- Electric drived switch
- Track circuit control unit



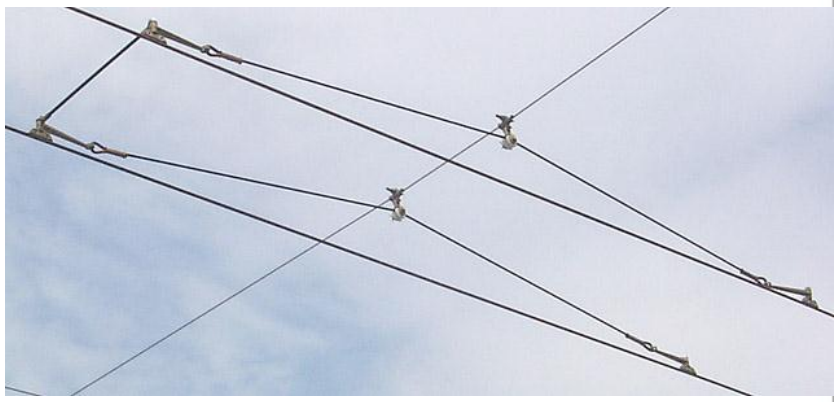
Positive experiences:

- The power units are working reliably (the oldest unit from 2002 without renewal)
- The switch control units are formed as requiered, able to change the rail direction

Negative experiences:

- The poor surface protection can lead to loss in efficiency and reduced reliability of the remote control

New technology:
Delta type overhead wire suspension



Positive experiences:

- The double clamping reduce the wire deformation in the suspension, sparing with the sliding carbon of the collector and reducing the wire abrasion as well.
- The integrated spacers reduced the possibility of short circuit and break in case of accident.
- The cochlear suspension compensates the heat expansion movement.

There is no negative experiences with the Delta suspension.

New technology:

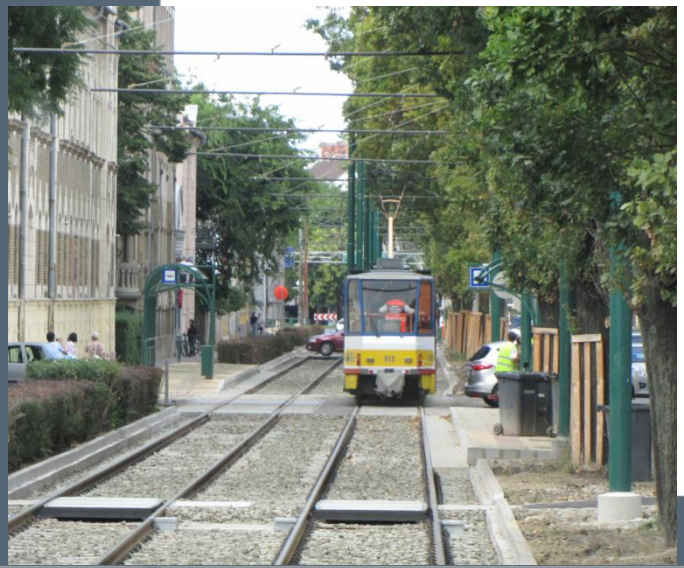
Fiberglass arms on the overhead mounting columns

Positive experiences:

- The fiberglass arms are durable and weather resistants.
- The dielectric arm increases employment security.
- Accident, arm fracture not cause short circuit directly.

Not concrete **Negative experiences** with the fiberglass arms yet.

Unfortunately there is no decorative design.



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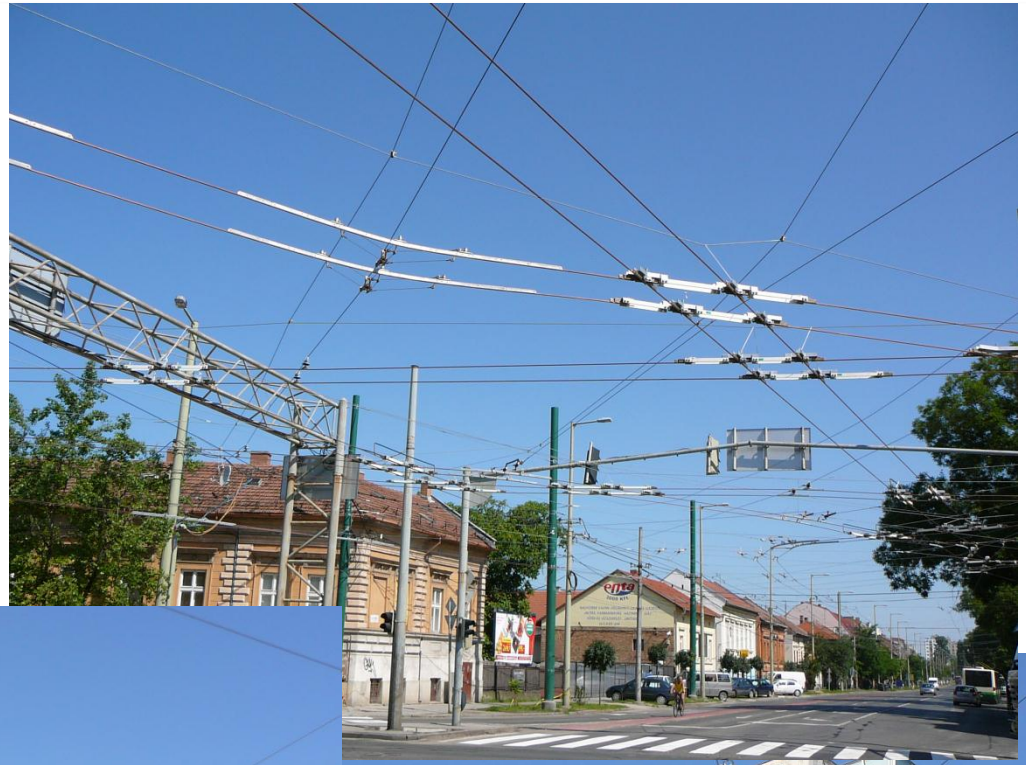

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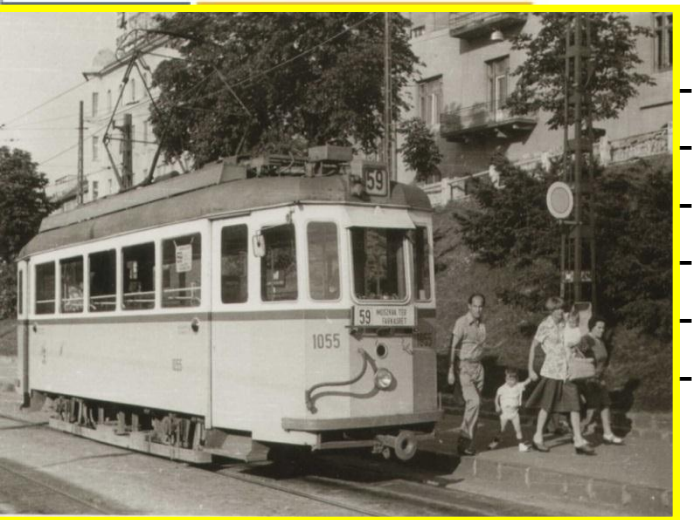
Players and Expectations:

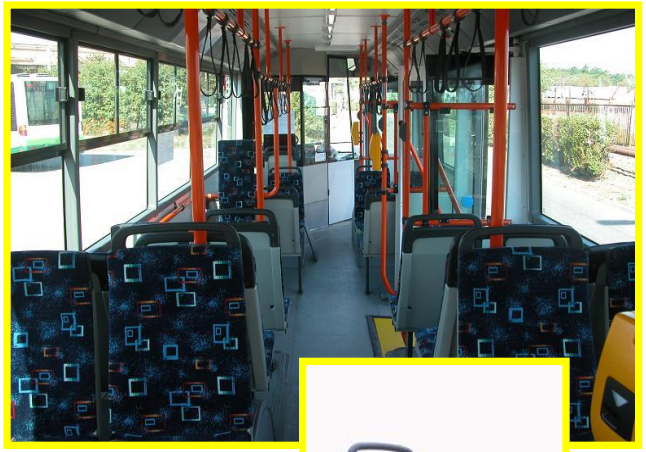


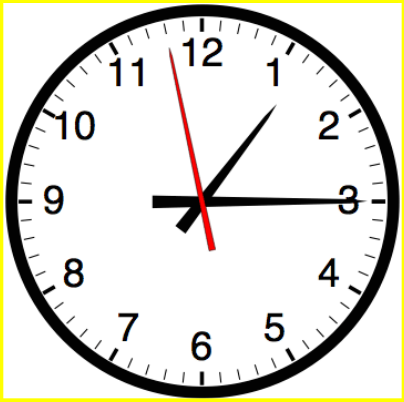
- Operator(s)
- Passenger(s)
- Urban resident(s)
- Responsible(s)
- Main office(s)
- Higher power(s)

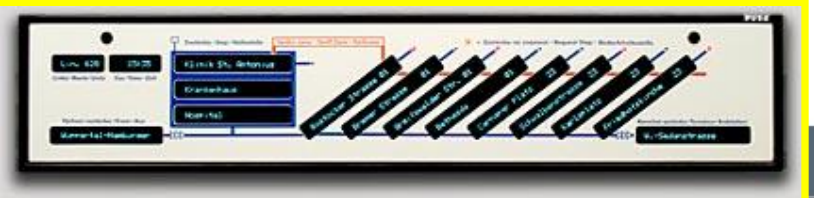
PT QUALITY!?

Positive experiences:
Need more

Negative experiences:
Be less

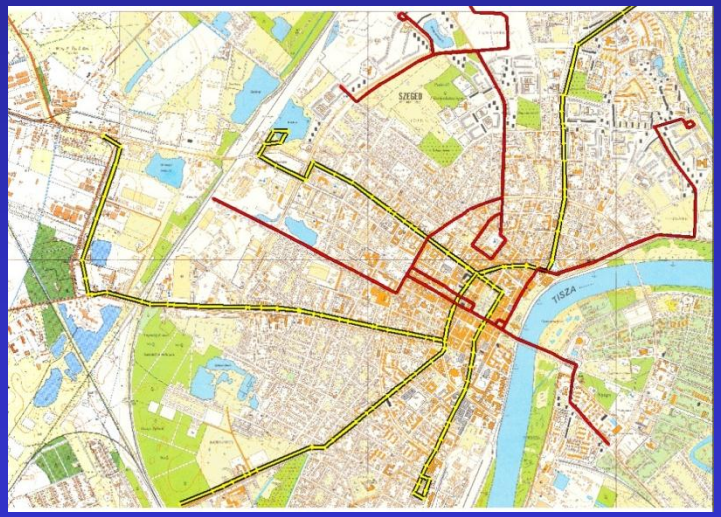




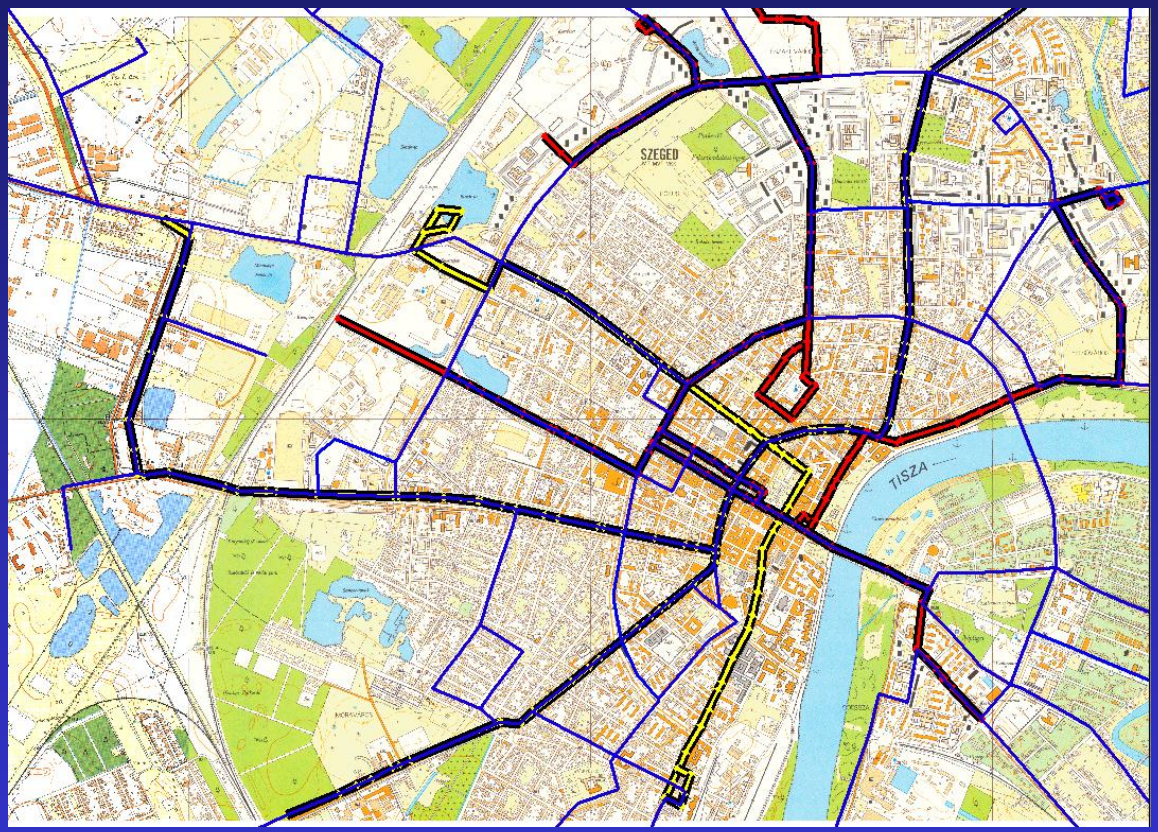


Public transport network in Szeged

Radial tramway network



Trolley network
On service of the housing estate



Feeder bus network

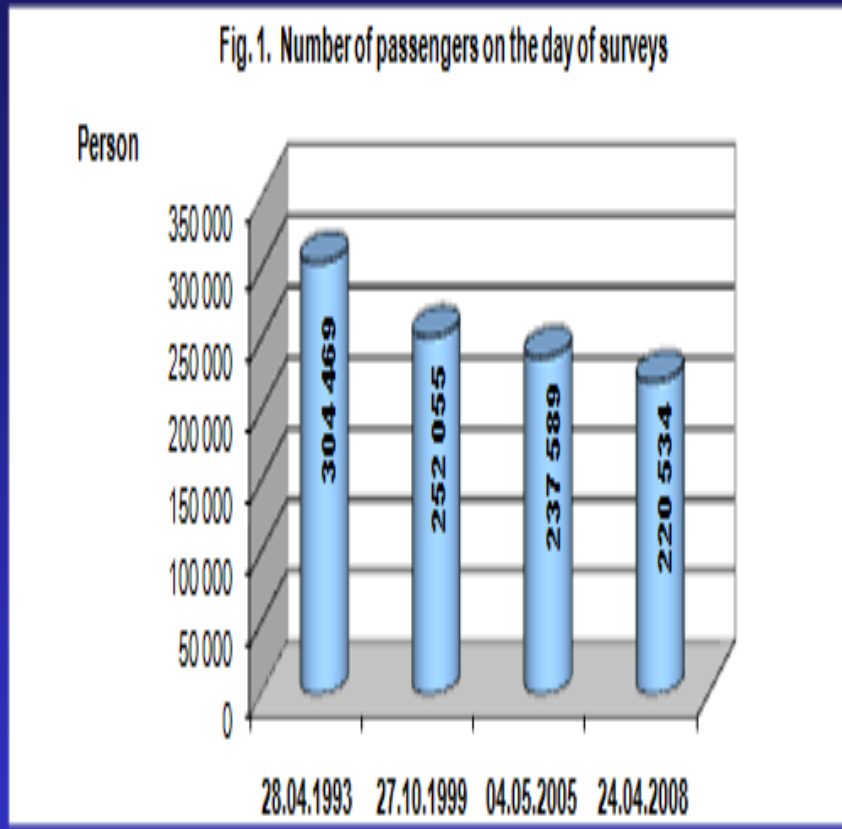
Real measured public transport data in 2008

	line length [km]	number of the daily trips	daily vehiclekm	daily capacitykm	daily passengers	daily pass.km	average distance[m]	capacity utilization
trams	37 (49,2)	730	3 883	554 060	57421	92814	1616	16,8%
trolley	44 (69,1)	949	5 310	588 435	50838	103263	2031	17,5%
SZKT all	**81 (118,3)**	**1 679**	**9 193**	**1 142 495**	**108259**	**196077**	**1811**	**17,2%**
Tisza Volán	**490 (?)**	**2 739**	**19 682**	**2 029 433**	**112275**	**350970**	**3126**	**17,3%**
In Total	**571 (?)**	**4 418**	**28 875**	**3 171 928**	**220534**	**547047**	**2481**	**17,2%**

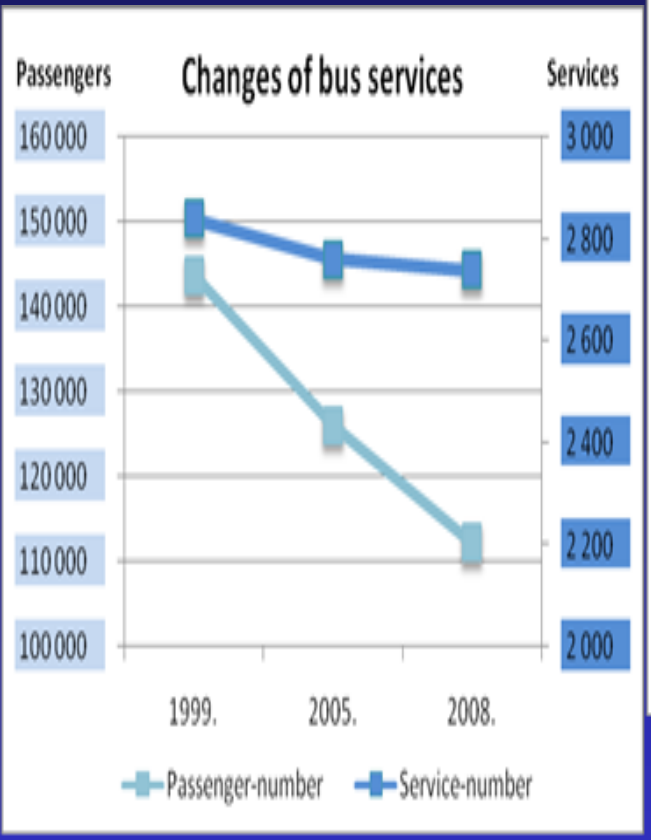
Trolley lines		line length[m]	person/day
5	Vértói út vá.	5300	2763
	Újszeged gyermekkórház vá.	5400	2774
7	Bakay N. utca	4100	822
	Újszegedi gyermekkórház vá.	4200	1273
8	Körtöltés u. vá.	4000 (5300)	3072
	Dugonics tér (Klinikák vá.)	4200 (5800)	3440
9	Makkosház vá.	7400	5378
	Lugas u.	7600	5465
19	Víztorony tér vá.	7500	
	Makkosháza vá.	7800	
10	Víztorony tér vá.	(4400)	
	Klinikák vá.	(4400)	

	1993	1999	2005	2008
Passenger number	304489	252055	237589	220534
-tram	66662	58237	60463	57421
-trolley	76437	50052	50973	50838
-bus	161370	143730	126153	112275
Trips per day	5130	4453	4399	4418
-tarm		846	758	730
-trolley		767	880	949
-bus		2840	2761	2739
Daily passenger-km	753000	632570	589377	548991
-tram	102408	87432	88009	92814
-trolley	167919	103939	102872	103263
-bus	482673	441199	398496	350970
Average travelling-m	2473	2510	2481	2480
-tram	1536	1500	1456	1616
-trolley	2197	2077	2018	2031
-bus	2991	3070	3159	3126
Capacity utilization	14,1%	18,4%	18,3%	17,2%
-tram	11,0%	16,4%	13,6%	16,8%
-trolley	15,5%	20,3%	19,9%	17,5%
-bus	13,5%	18,5%	19,3%	17,3%

Reducing tendency



Changes of buses, trams, trolleys

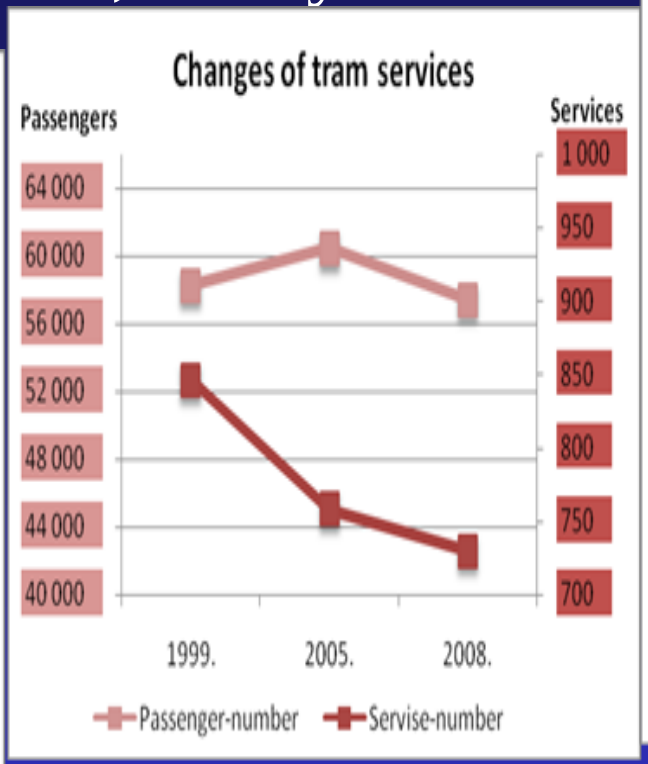


Passengers:

- 1999-2005: -2,0%/year
- 2005-2008: -3,7%/year

Services:

1999-2008: -3,4% total

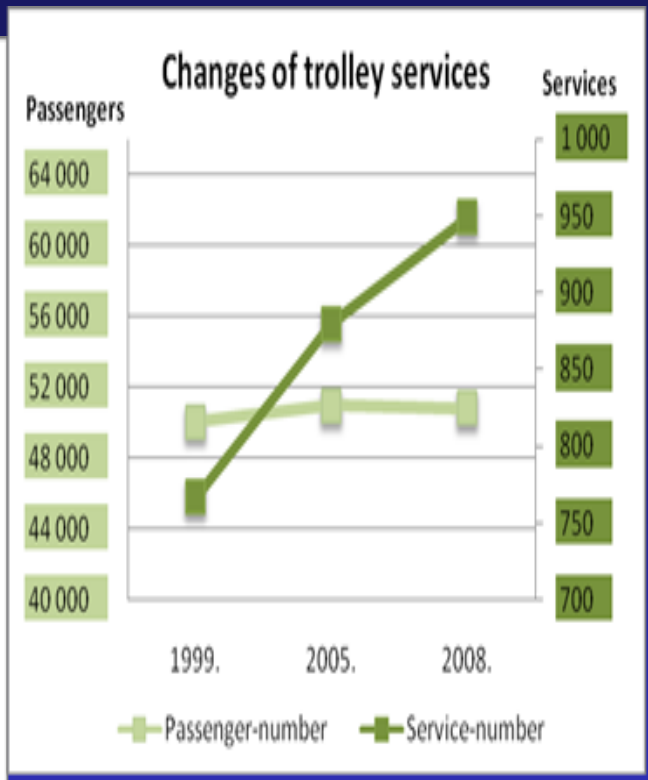


Passengers:

- 1999-2005: increasing
- 2005-2008: reduction

Services:

- 1999-2005: 10% reduction
- 2005-2008: 3,7% decrease



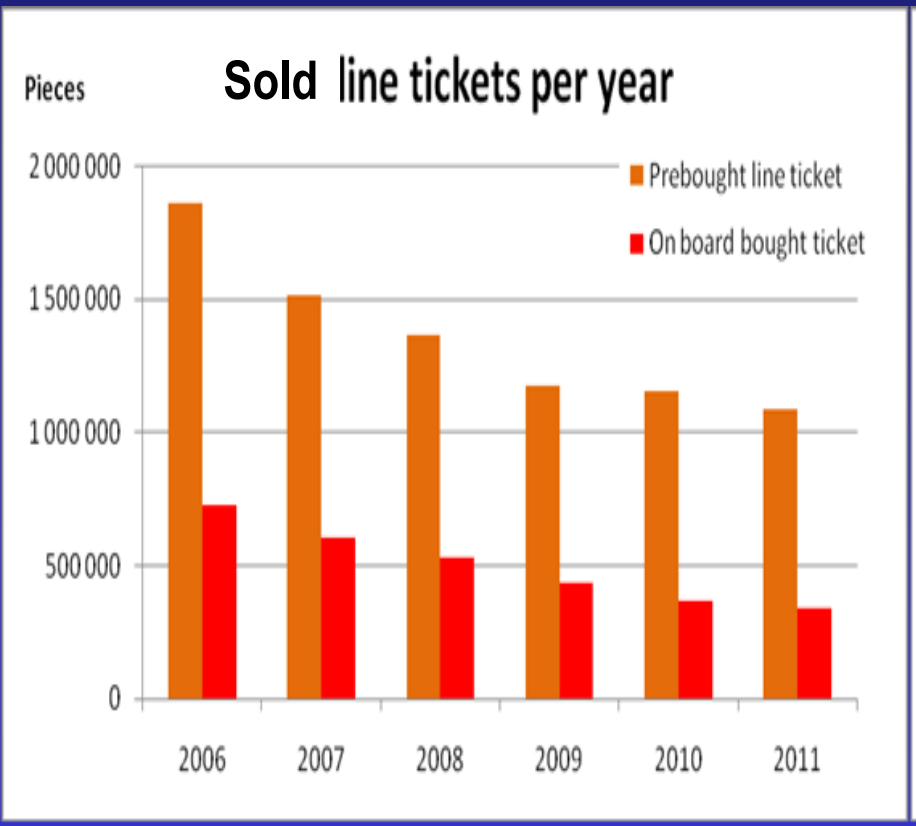
Passengers:

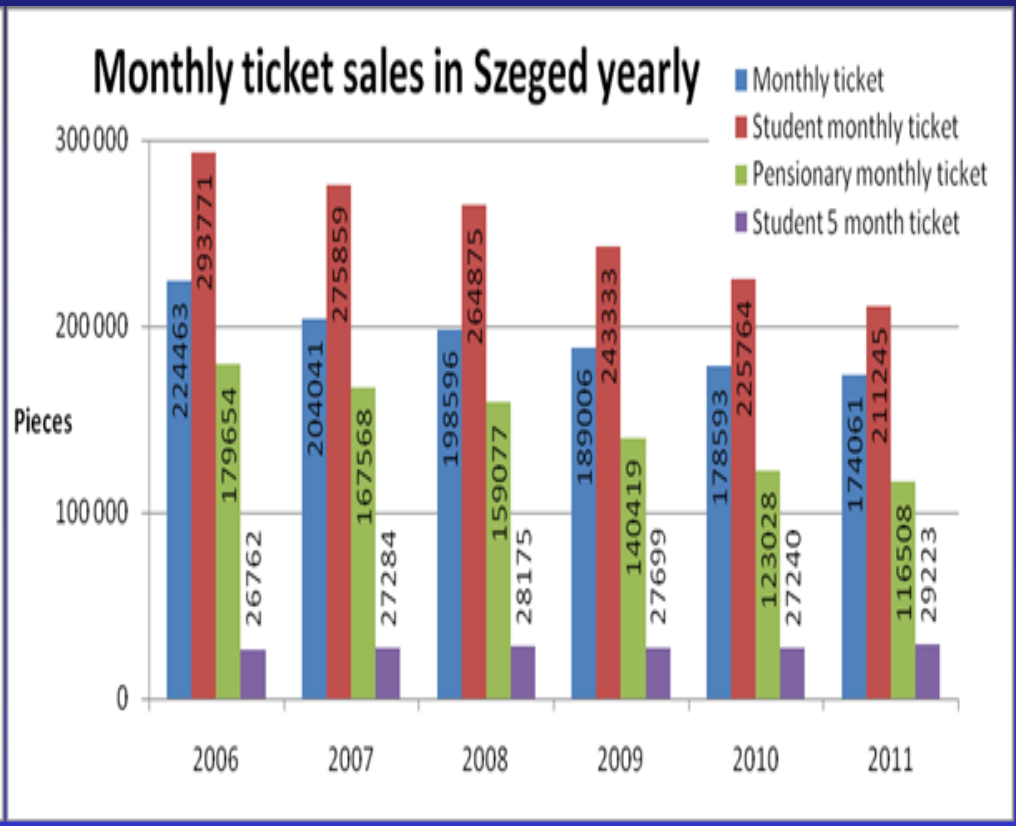
- 1999-2008: gentle rise

Services:

- 1999-2008: strong increase

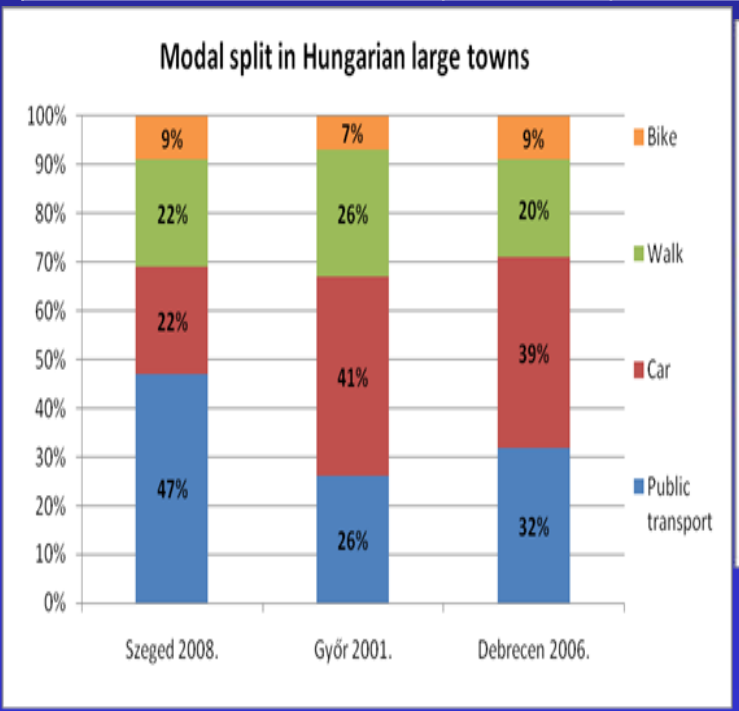
CHANGES IN TRANSPORT HABIT

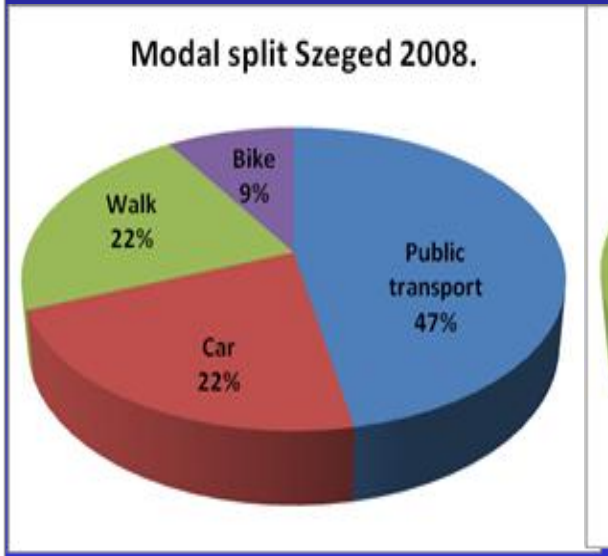




MODAL SPLIT CHANGES based on sales

	2006.	2007.	2008.	Modal split 2008.	2009.	2010.	2011.	Modal split 2011.
Total daily trip by public transport	243 700	228 172	220 534	47%	203 195	190 001	182 365	37%
Total daily trip by car			103 229	22%			103 229	21%
Total daily trip on foot			103 229	22%			113 551	23%
Total daily trip by bike			42 230	9%			93 537	19%
Total daily trip			469 222	100%			492 682	100%





Szeged in the language of the emission

(g/person)	Public transport	100 % electric public transport	Car 1 person	Car 2 person	Car 4 person
CO2	121,9144419	74,51157	503,4375	251,7188	125,8594
CO	0,9372381	?	1,875	0,9375	0,46875
HC	0,172111	?	0,1875	0,09375	0,046875
NOx	0,73212713	0,0793088	0,325	0,1625	0,08125
SO2	0,02950292	0,0459194	?	?	?
PM	0,0098183	0,0071651	0,0125	0,00625	0,003125

Car with 2 person has better CO, HC and PM emission than public transport.
The higher comfort (cooling, heating, information service…) of the electric public transport require more energy, can be doubled, at least necessary to consider and to **determine the optimal „plant size”.**
One Szeged size settlement with such transport structure and habit and vehicle fleet and service level already on the „green” limit.

The „pocket-emission” parameter,
usually named as expense, but has immediate effect:
- Until for a car driver 1 km cost 28-38 Ft, a public transport user for 3*30*2,48=223,2 km in a month buy pass for 6830 Ft, so travels for 30,7 Ft/km. If buy ticket, couses financial collapse! (By car the same 223,2 km monthly cost max. 8284 Ft the 19 l gasoline, and the annual 2678 km will not cause more extra costs than the shoe-wear or garment wear.)

The „distance emission” parameter,
the time, the parameter that sometimes unpayable:
- in Szeged the biggest distance by car max. 20 minutes. By public transport needs about one hour. In traffic jam uniformly increasing the time.

Other relevant questions:

- What costs the public transport built-up?
- What costs the public transport vehicle?
- What vehicle damage more the roads and the stops?
- What costs the public transport at all?
- Who pays for it? Resources?

CONCLUDING QUESTIONS

- How the public transportation of Szeged can be in long-term kept up?
- The public transport is: competitive service comparing the cars, or social supply?
- In the name of the sustainability what kind of other incomes are needed to be built in the system beside the income from ticket-sales, and how those will finance the Public Transport?
- What is the awaited comfort level and how much more should we pay for the added services indeed?
- How to understand the Practical city definition? Practical as enterprising, accessible and safe, healthy and attractive. We have to force in every possible ways the citizens to use the optimal travelling manners with less volume, lower environment pollution etc. In that sense we must interest citizens in voluntary change of behaviors. Or – the payable, not prohibited, sponsorable city?

Thank You for Your attention!

Some urban vehicle's final and primary energy consumption in Germany in 2000, and nowadays own data collection [ ].

Vehicle	Energy source	Final energy consumption	Final energy (Mj/km)	Energy (kWh/km)	Passengers	Primer energy (kJ/fhkm)
Car	Gasoline	6-15 l/100 km (10,4) [9]	1,9-4,8 (3,4) [3,1]	[0,861]	5	460-1140 (790)
Car	Diesel	3,5-11 l/100 km (8,3) [7,5]	1,3-3,9 (3,0) [2,8]	[0,778]	5	280-890 (670)
Bus 2000	Diesel	43,8 l/100 km [41,6]	15,6 [15,3]	[4,25]	75	235
12 m bus	Diesel	40 l/100 km [36]	14,3 [12,9]	[3,583]	66	244
Articulated bus	Diesel	55 l/100 km [50]	19,7 [17,8]	[4,944]	102	217
Bus 2000	CNG	54,4 m^3/100 km	19,6	[5,444]	75	315
12 m bus	CNG	49,7 m^3/100 km	17,9	[4,9]	66	327
Articulated bus	CNG	68,3 m^3/100 km	24,6	[6,833]	102	291
Tram	Electricity	(28 Wh/roomkm) [0,8-3 kWh/km] [1,6]	2,9-10,8 [5,8]	[1,6]	n. a.	309
Trolley	Electricity	[1,5-3,8 kWh/km] [2,2]	5,4-13,7 [7,9]	[2,2]	75	

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The specific data on 1 km.

MJ/l (MJ/m3)	34,2	37,3	35,75	37,3	37,3	37,3	39,128	39,128	39,128		
co2	24	26,5		26,5	26,5	26,5	181,2462	181,2462	181,2462	298,046	298,046
	car			bus	diesel		bus	CNG		tram	trolleybus
	gasoline	diesel	average	solo	articulated	average	solo	articulated	average		
l/100km	8,5	7,5	8	36	50	45					
m3/100 km							49,7	68,3	54,4		
kWh/km	0,808	0,777	0,794	3,730	5,181	4,663	5,402	7,423	5,913	1,6	2,2
CO2	204	198,75		954	1325	1192,5	979,0626	1345,472	1071,65	476,8736	655,7012
CO	1	0,5		5,595	7,770833	6,9938	0,334722	0,45999	0,366376	?	?
HC	0,1	0,05		1,7158	2,383056	2,1448	0	0	0	?	?
NOx	0,06	0,2		7,46	10,36111	9,325	0,769861	1,057978	0,842665	0,507576	0,697917
SO2	?	0		0	0	0	0,008368	0,0115	0,009159	0,293884	0,404091
PM	0,005	0,005		0,0746	0,103611	0,0933	0,058576	0,080498	0,064116	0,045856	0,063052
Ft/km	29,155	24,525									

Comparison. Electric and diesel emissions in Europe (2004)

$g/kWh_{electric}$

	D	A	NL
CO	0,168	0,101	0,030
CO_2	637,3	227,2	506,0
HC	1,891	0,927	0,013
NO_x	0,580	0,246	0,471
SO_2	0,595	0,159	0,227

g/kWh_{diesel}

	D	A	NL
CO	0,035	0,036	0,205
CO_2	29,448	29,921	36,660
HC	0,134	0,136	0,279
NO_x	0,107	0,109	0,116
SO_2	0,182	0,185	0,406

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Promoting electric public transport

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Rough comparision for Szeged

	Line-length (km)	Number of the daily trip	Daily vehicle-km (km)	Daily pasenger number (person)	Daily passenger-km (pkm)	Average tarvelling distance (m)	Daily passenger capacity-km (pckm)	Capacity utilization	Daily energy usage (kWh)	Car equivalent (kWh)
Tram	37	730	3883	57421	92814	1616	554060	16,8 %	6213	
Trolley	44	949	5310	50838	103263	2031	588435	17,5 %	11682	
SZKT total	81	1679	9193	108259	196077	1811	1142495	17,2 %	17895	158414
Tisza Volán	490	2739	19682	112275	350970	3126	2029433	17,3 %	95359	283585
In total	571	4418	28875	220534	547047	2481	3171928	17,2 %	113254	441999

Daily 220534 passenger 28875 km public transport use about 100000 kWh ,
i.e. about 0,5 kWh/person
electric public transport 56000 kWh ~ 0,25 kWh/person
220534 passengers 547145 km car 1 person about 400000 kWh, 2 kWh/person
car 2 person ~ 200000 kWh, 1 kWh/person
car 4 person ~ 100000 kWh, 0,5 kWh/person