PLEEC

PLANNING FOR ENERGY EFFICIENT CITIES

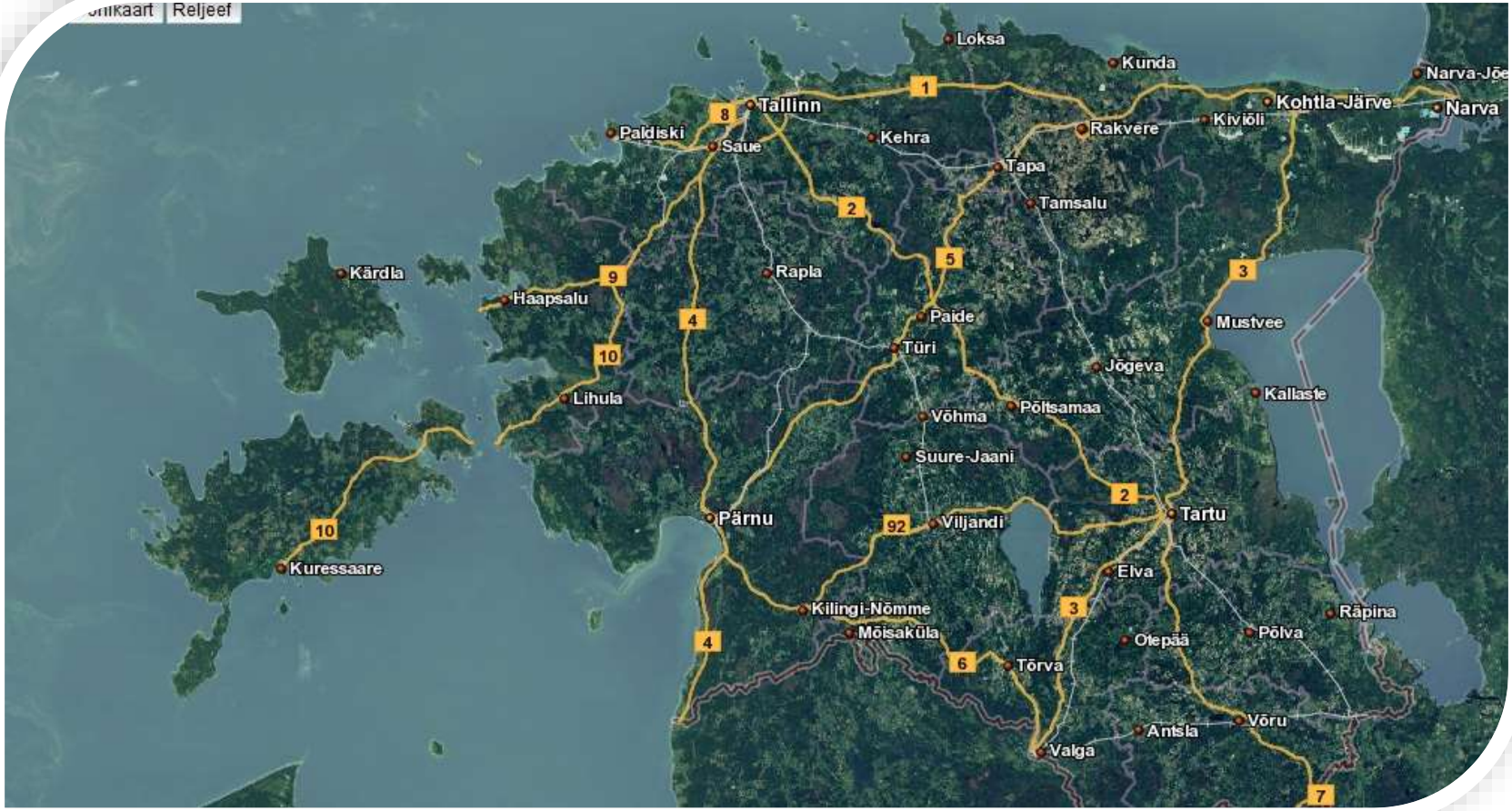
TARTU

Energy Efficency Action Plan

Kaunas 25.02.2016

SEVENTH FRAMEWORK PROGRAMME

This project is financed by the European Union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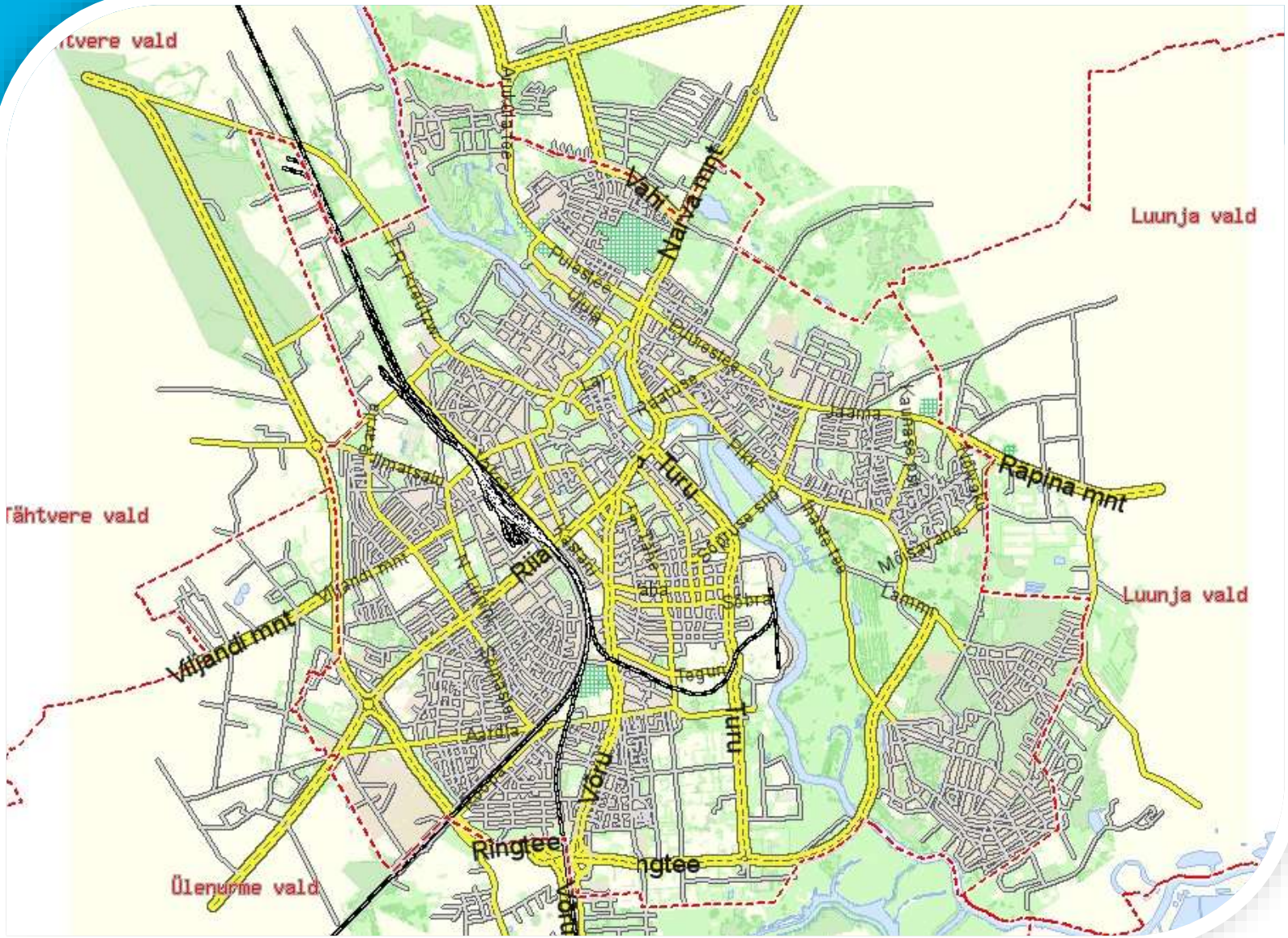
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Symbols

Arms of Tartu

Flag of Tartu

Logo of Tartu

Tartu City Day
June 29

Tartu is the second largest city in Estonia.

Tartu first mentioned in written	1,030
Highest point above sea level	79 m
Area	38.87 km^2

Popullation

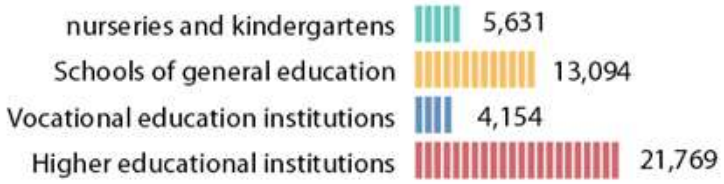
Number of inhabitants in Population Registry

1.01.2015	97,079
1.01.2014	97,847
1.01.2013	98,480
Density per sq km	2,492

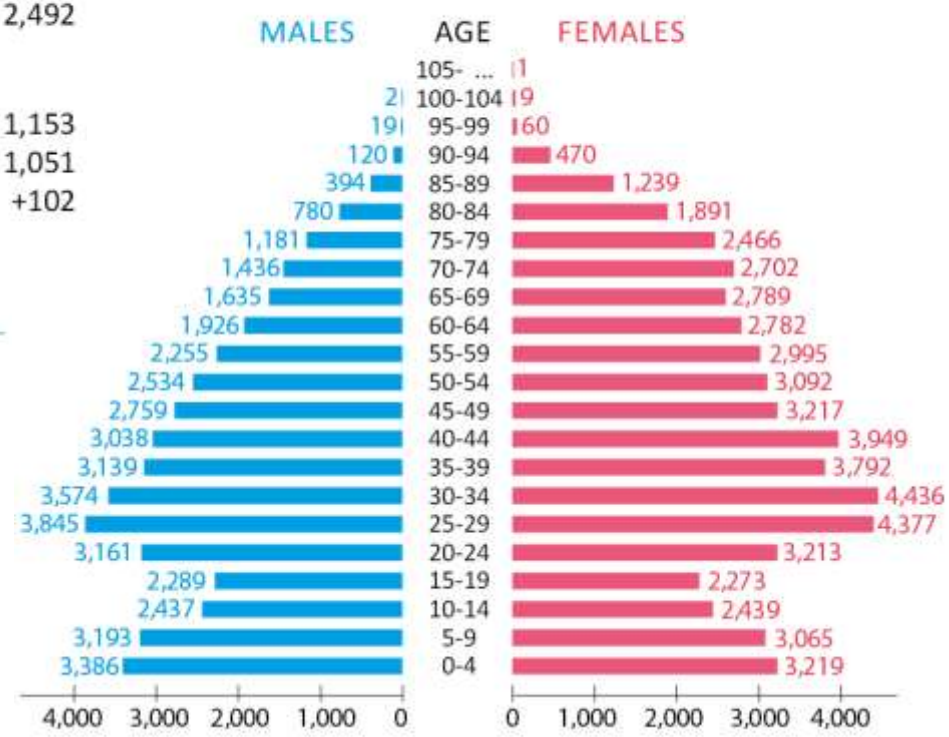
Natural increase in 2014

Number of live births	1,153
Number of deaths	1,051
Natural increase	+102

Number of students 10.09.2012



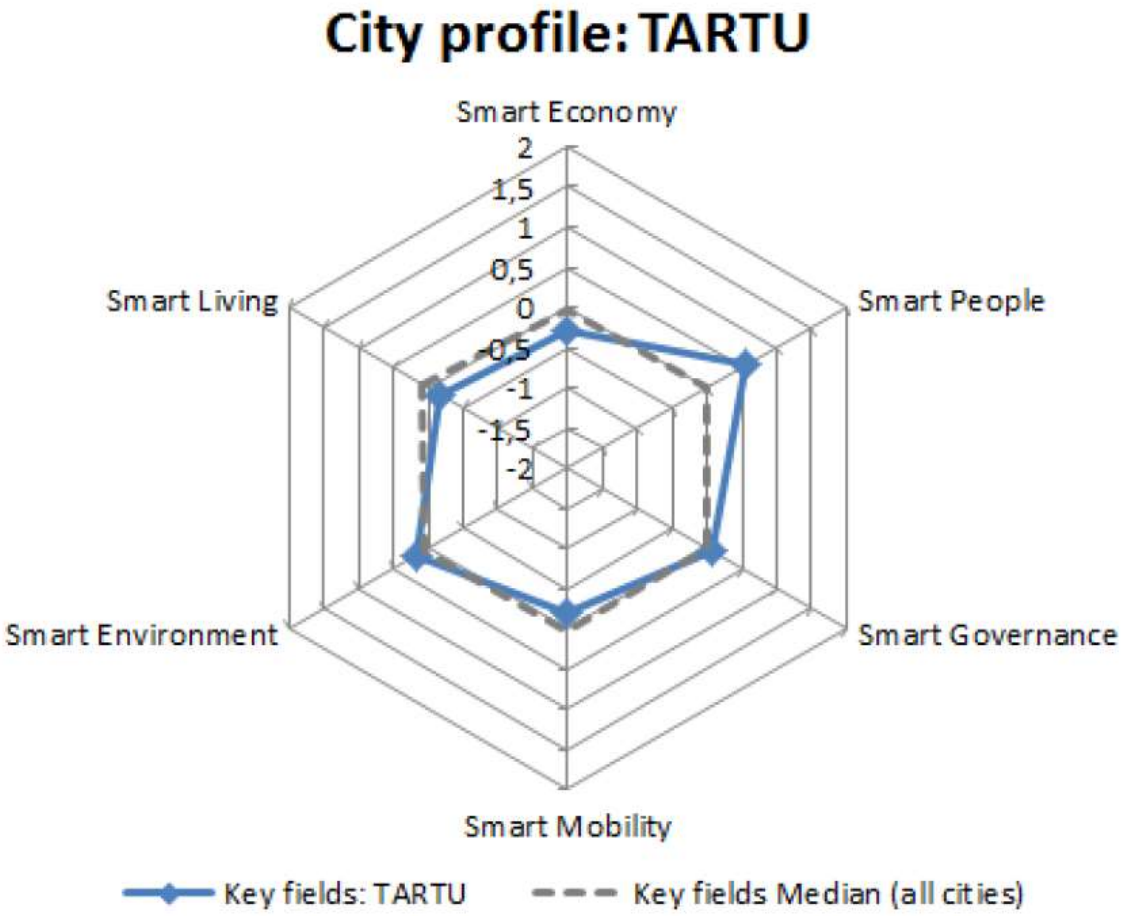
Population by age and sex 1.01.2015



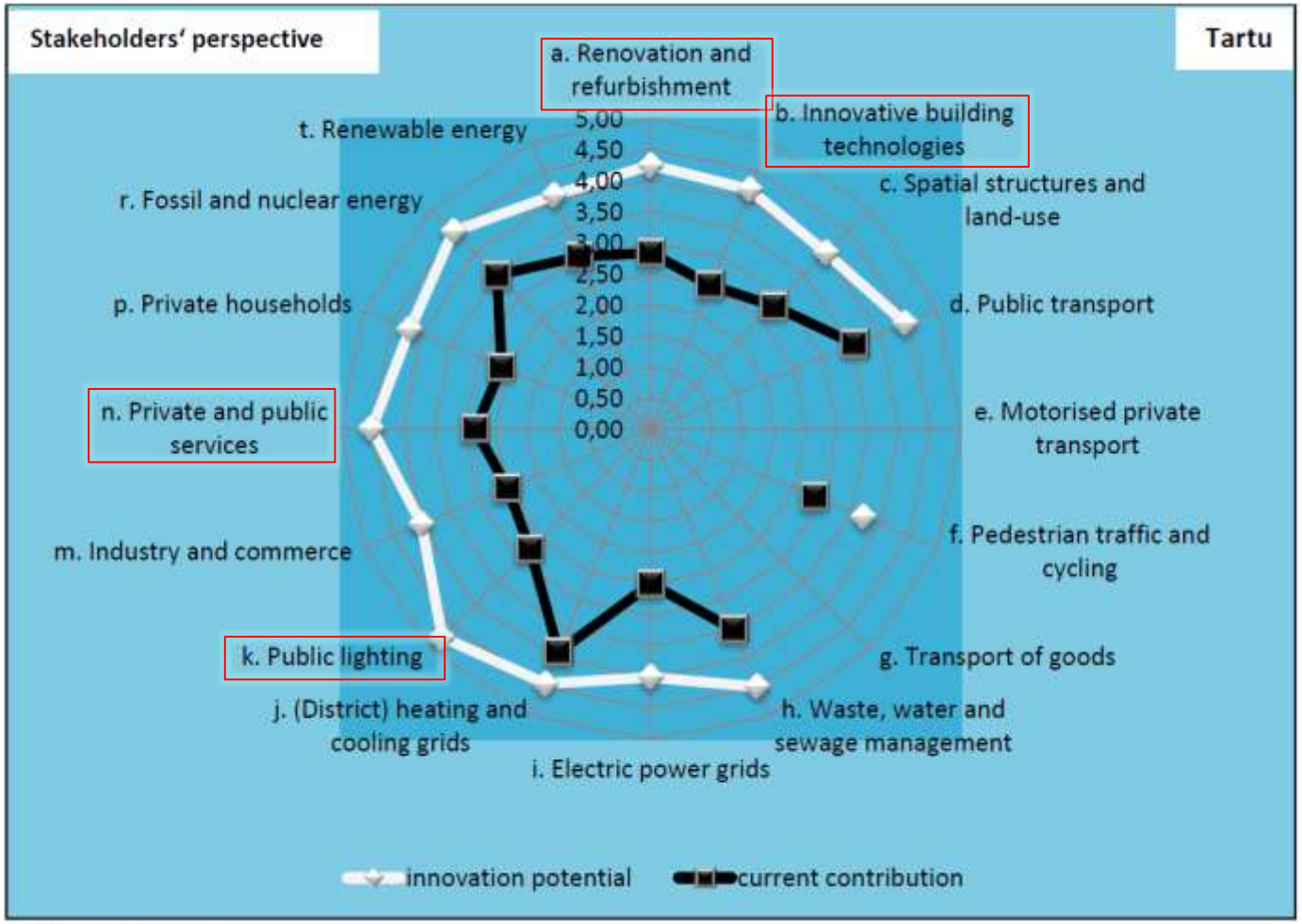
Economy

- City of education
  - 5 vocational education institutions
  - 11 Higher educational instituions
  - Tartu University founded in 1632
- Health care center
- Food production
- Concrete production
- Modular house factories
- Mostly services
- No large scale industry

Tartu Smart City Profile



Tartu Smart City Profile



Tartu Energy Efficiency Action Plan

Tartu EEAP :

- a work-document for city government
- focus on city administration, local authority (WP2 results)
- focus on action that will have impact between 2016 and 2020
- focus on actions that are directly measurable
- focus on (WP2 results):
  - public lighting
  - renovation and refurbishment
  - utilizing innovative building technologies

Goals

Goal 1: by yr. 2020 to maintain the energy consumption level of yr. 2010 (Eesti 2020)

Goal 2: by yr. 2020 to maintain electricity consumption of year 2010.

Methology

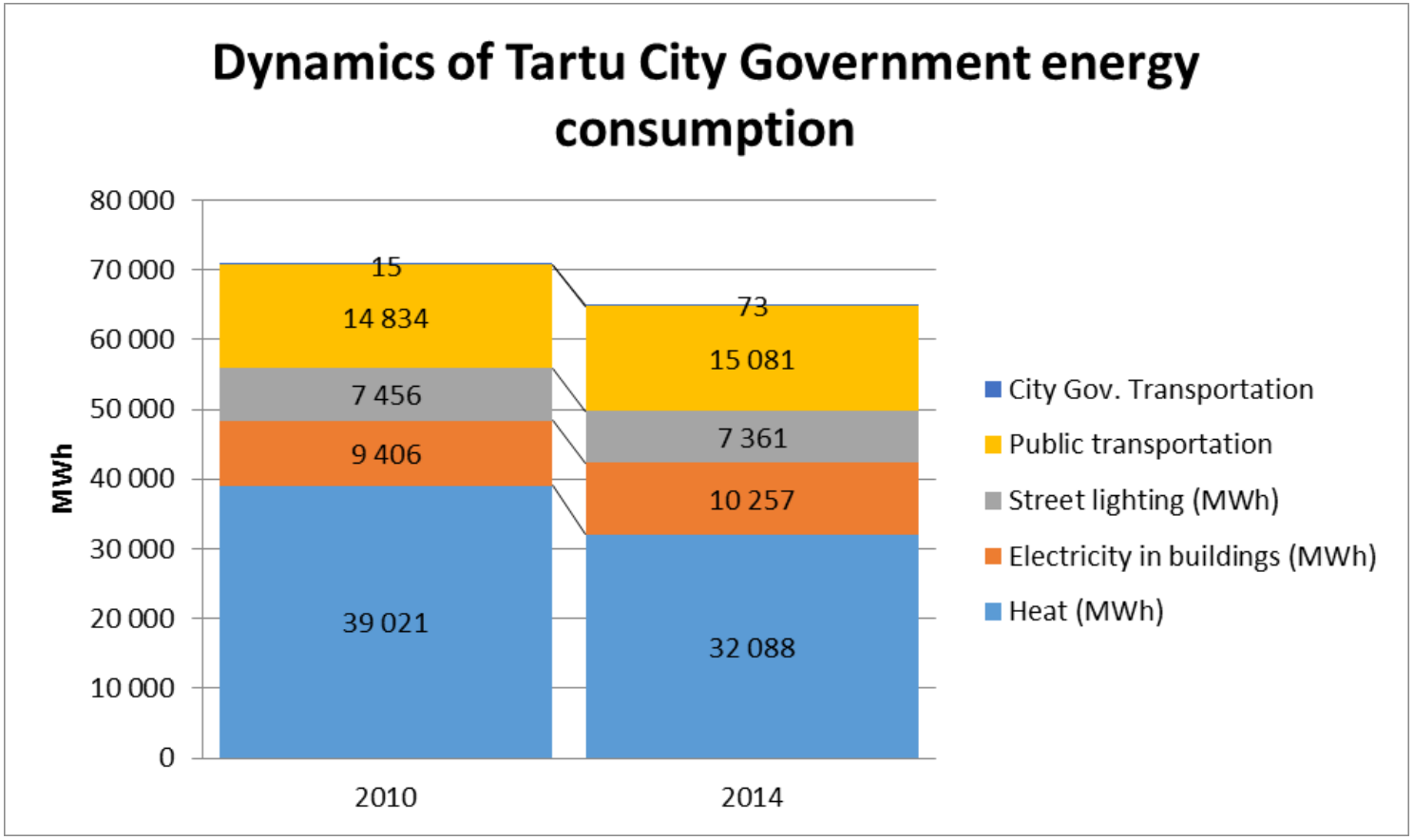
Step 1: Set goals
Step 2: energy consumption in 2010
Step 3: energy consumption in 2014
Step 4: evaluate energy efficiency steps taken between 2010 and 2014
Step 5: calculate energy consumption for 2020 by planned investments
Step 6: create additional plan for actions to reach goals

Tartu City Government consumes energy in form of:

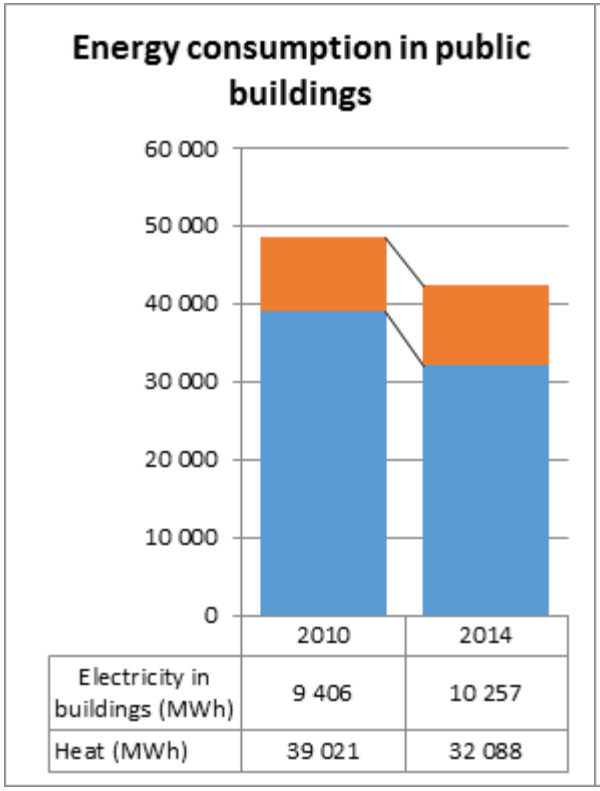
- heat in public buildings
- electricity in public buildings
- electricity in street lighting
- energy in public transport
- energy in city government transport

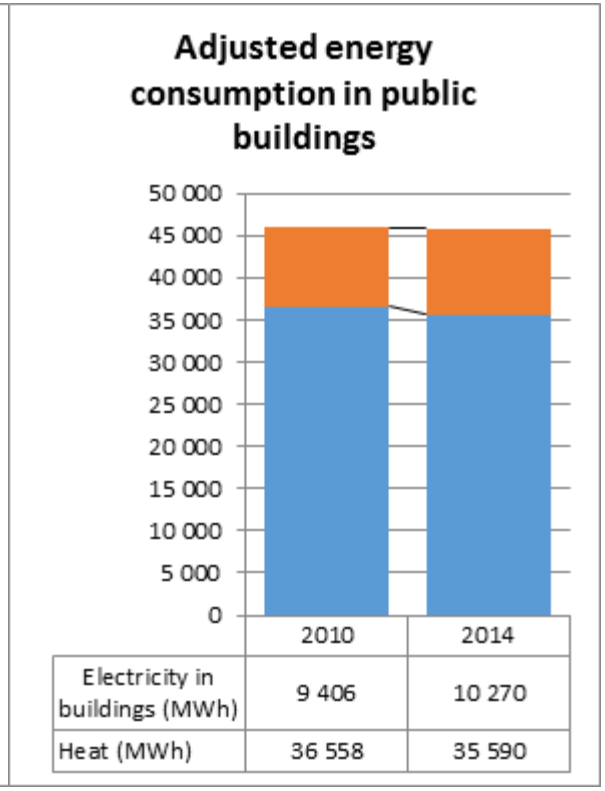
2010 and 2014 public building heat consumption is made comperable through nationally agreed adjustment methodology developed by Tallinn Technical University.

Energy consumption 2010, 2014



Energy consumption in pub.buildings 2010 vs 2014





	De-crease (MWh)	De-crease
Adjusted Heat	-968	-2,6%
Electricity in buildings	865	9,2%
TOTAL	-103	-0,2%

Energy Efficiency investments

Goal: reducing energy consumption in public buildings.

Funded by sale of national CO2 emission quotas

14 buildings

Total cost 6 023 216 Euros

Results of energy efficiency investments in schools

Results of investment into 8 schools

Year	2010	2014	Change (total)	Change %
Heat, MWh	6081,6	4535,7	-1546,0	-25%
Heat, MWh/m2	0,134	0,100	-0,034	
Adj. heat. MWh	**5688,1**	**4981,2**	**-706,9**	-12%
Adj. heat. MWh/m2	0,125	0,109	-0,016	
Electricity MWh	**1313,0**	**1452,9**	**139,9**	11%
Electricity MWh/m2	0,0289	0,0319	0,003	
TOTAL (Adj.heat + Electricity)	7001,2	6434,2	-567,0	-8%
Premices (m2)	45 500			
KWh/m2/a	**153,9**	**141,4**		-8%
No. of children	5484	5074	-410	-7%

Tartu Kivilinna School

- Renovation of central heating system
- Full insulation of walls, roof and basement.
- Heat consumption in 2010: 926 MWh; 128 kWh/m2
- Heat consumption in 2014: 662,1 MWh; 92 kWh/m2
- Heat consumption change: - 26%
- Savings per year: 15 700 EUR

Tartu A.Puskin school

- Renovation of central heating system
- Full insulation of walls, roof and basement.
- Fully renovated ventilation system
- Fully renovated kitchen

Tartu A.Puskin school

-	Heat consumption in 2010:	669 MWh;	98 kWh/m2
-	Heat consumption in 2014:	723 MWh;	105 kWh/m2
-	Heat consumption change:	+ 8%	
-	Electicity consumption in 2010:	134 MWh	
-	Electricity consumption in 2014:	209	
-	Electricity consump. change:	+ 56%	

Results of energy efficiency investments in kindergartens

Results of investment into 6 kindergartens

Year	2010	2014	Change (total)	Change %
Heat, MWh	2049,2	1330,1	-719,1	-35%
Heat, MWh/m2	0,211	0,137	-0,074	
Adj. heat. MWh	**1927,1**	**1443,1**	**-484,0**	**-25%**
Adj. heat. MWh/m2	0,199	0,149	-0,050	
Electricity MWh	**208,6**	**218,4**	**9,8**	**5%**
Electricity MWh/m2	0,022	0,023		
TOTAL (Adj.heat + Electricity)	2135,7	1661,6	-474,1	-22%
Premices	9693,6			
KWh/m2/a	**220,3**	**171,4**		
No. of children	1185,0	1195,0	10,0	1%

Tartu Kindergarten Sass

- Insulation of outer walls
- Fully renovated kitchen
- Two new rooms in neigbouring building
- No of children increase by 25%

- Heat consumption in 2010:	215 MWh;	229 kWh/m2
- Heat consumption in 2014:	191 MWh;	203 kWh/m2
- Heat consumption change:	-11%	
- Electricity consumption in 2010:	41 MWh	43 kWh/m2
- Electricity consumption in 2014:	56 MWh	60 kWh/m2
- Electricity consump. change:	+ 37%	

Tartu Kindergarten Tõruke

Investments:

- Fully renovated central heating system
- Full insulation
- Fully replaced doors and windows

- Heat consumption in 2010:	210 MWh;	269 kWh/m2
- Heat consumption in 2014:	99 MWh;	126 kWh/m2
- Heat consumption change:	-53 8%	
- Electicity consumption in 2010:	27 MWh;	35 kWh/m2
- Electricity consumption in 2014:	22 MWh	29 kWh/m2
- Electricity consump. change:	- 18%	

Findings

- Only full renovation is financially reasonable
- Payback period for small investments can reach to hundreds of years
- Highest savings come from renovation of central heating system
- Leaving parts of a building uninsulated can decrease potential savings by 2 times.
- Investments have drasticly improved indoor climate
- Investment into energy efficiency is possible only when indoor climate quality is upto standards
- Reaching indoor climate and lighting standards can more then double an existing building’s electricity consumption.
- For Tartu decreasing heat consumption has little to no impact on climate
- For Tartu increasing electricity consumption has large impact on climate and Eastern-Estonian nature.

Results other investments

Results of investment into 6 kindergartens

Year	2010	2014	Change (total)	Change %
Heat, MWh	4697,2	4436,3	-260,9	-6%
Heat, MWh/m2	0,220	0,195	-0,025	-11%
Adj. heat. MWh	4418,3	4839,8	421,5	10%
Adj. heat. MWh/m2	0,207	0,213	0,006	3%
Electricity MWh	**359,0**	**467,6**	**108,6**	**30%**
Electricity MWh/m2	**0,017**	**0,021**	**0,0**	**22%**
TOTAL (Adj.heat + Electricity)	4777,2	5307,4	530,1	11%
Premices	21364,8	22720,5	1355,7	6%
KWh/m2/a	243,4	249,4	6,1	2%
No. of children	2030,0	2195,0	165,0	8%

Overall result of the investments:
- 13 new classrooms
- 174 additional places
- Additional 1356 m2 or increase by 6%

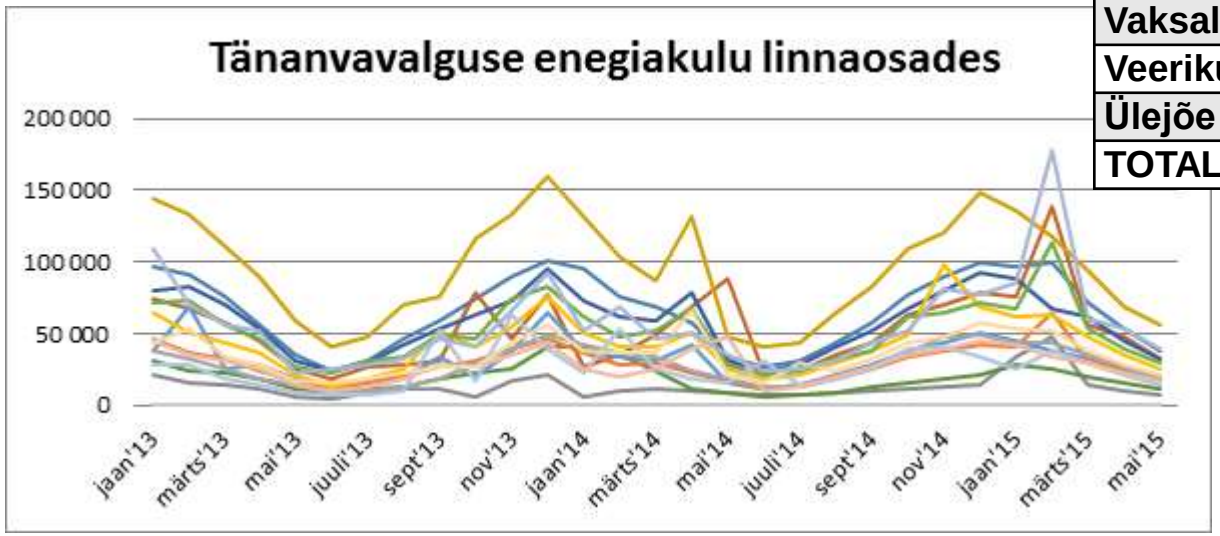
- Overall increase of heat consumption by 10%
- Relative increase of heat consumption 3% per m2

- Increase of electricity consumption by 30%
- Relative increase of electricity consumption 22% per m2

Energy consumption in street lighting

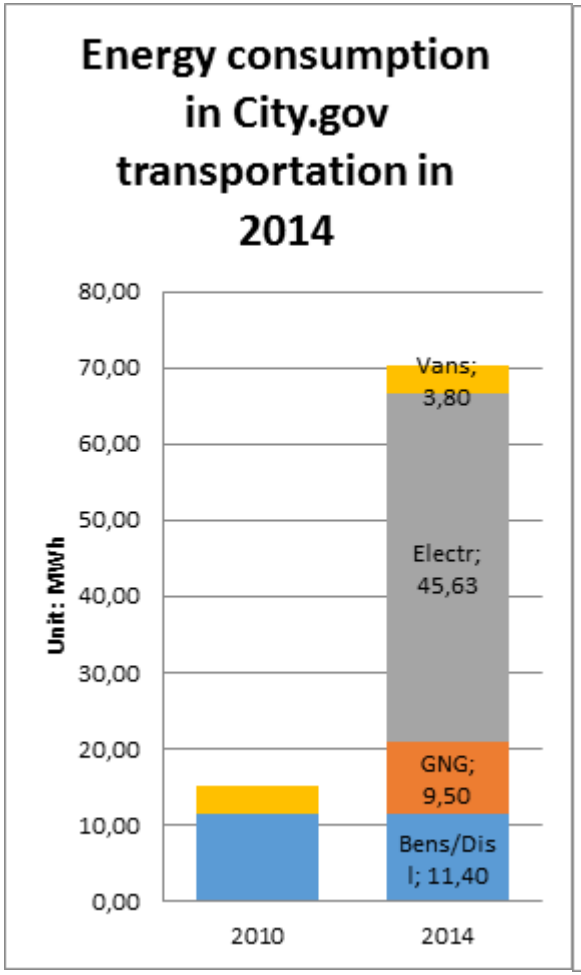
2010: 7 456 MWh of electricity
2014: 7 361 MWh of electricity

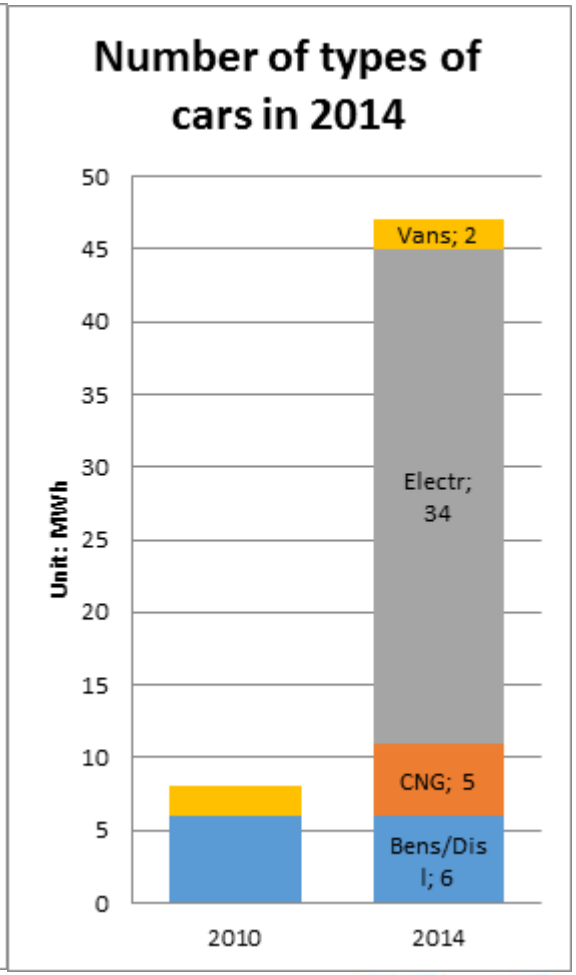
District	2014 (MWh)	Share
Annelinn	755	10%
Ihaste	605	8%
Jaamamõisa	121	2%
Kesklinn	1 112	15%
Karlova	689	9%
Maarjamõisa	209	3%
Raadi-Kruusamäe	371	5%
Ropka	319	4%
Ropka industreal district	358	5%
Ränilinn	530	7%
Tammelinn	572	8%
Tähtvere	338	5%
Vaksali	347	5%
Veeriku	450	6%
Ülejõe	587	8%
TOTAL	7 361	100%



Energy consumption in Transportation

Public transportation:
2010: 3 600 000 km; 14 834 MWh
2014: 3 660 000 km; 15 081 MWh
City gov. Transportation:
2010: 15,2 MWh
2014: 70 MWh





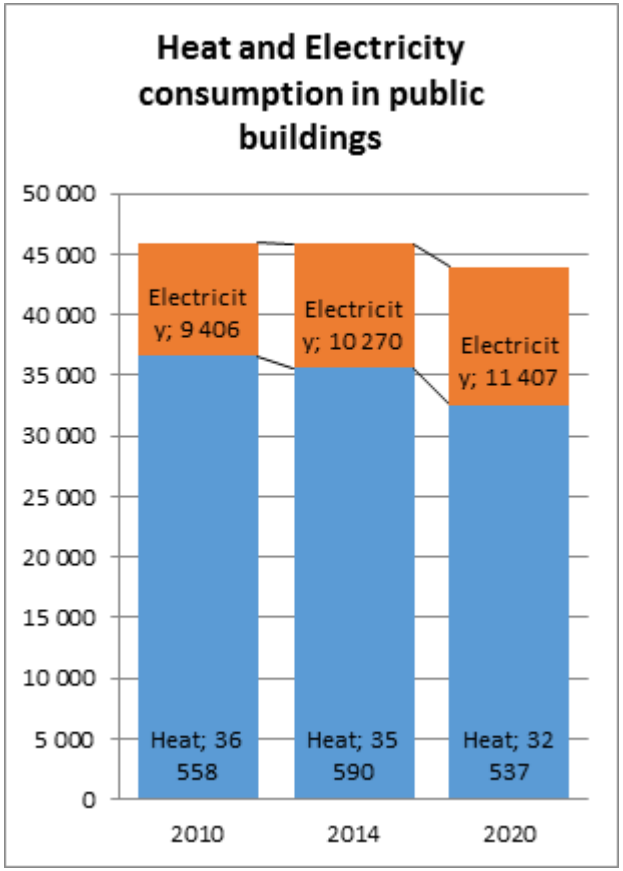
Tartu City Gov. Energy Consumption in 2020

	2010 (MWh)	2014 (MWh)	2020 (MWh)	20vs10 (MWh)	20vs14 (MWh)	20vs10	20vs14
Heat (adjusted)	36 558	35 590	**32 634**	-3 924	-2 956	**-11%**	-8%
Electricity in buildings	9 525	10 270	**11 484**	+1 959	+1 214	**+21%**	+12%
Street lighting	7 456	7 361	**3 887**	-3 569	-3 475	**-48%**	-47%
Public transportation	14 834	15 081	**16 482**	+1 648	+1 401	**+11%**	+9%
City Gov. Transportation	15	73	**94**	+79	+21	**+517%**	+29%
TOTAL	**68 388**	**68 375**	**64 581**	**-3 807**	**-3 795**	**-6%**	**-6%**

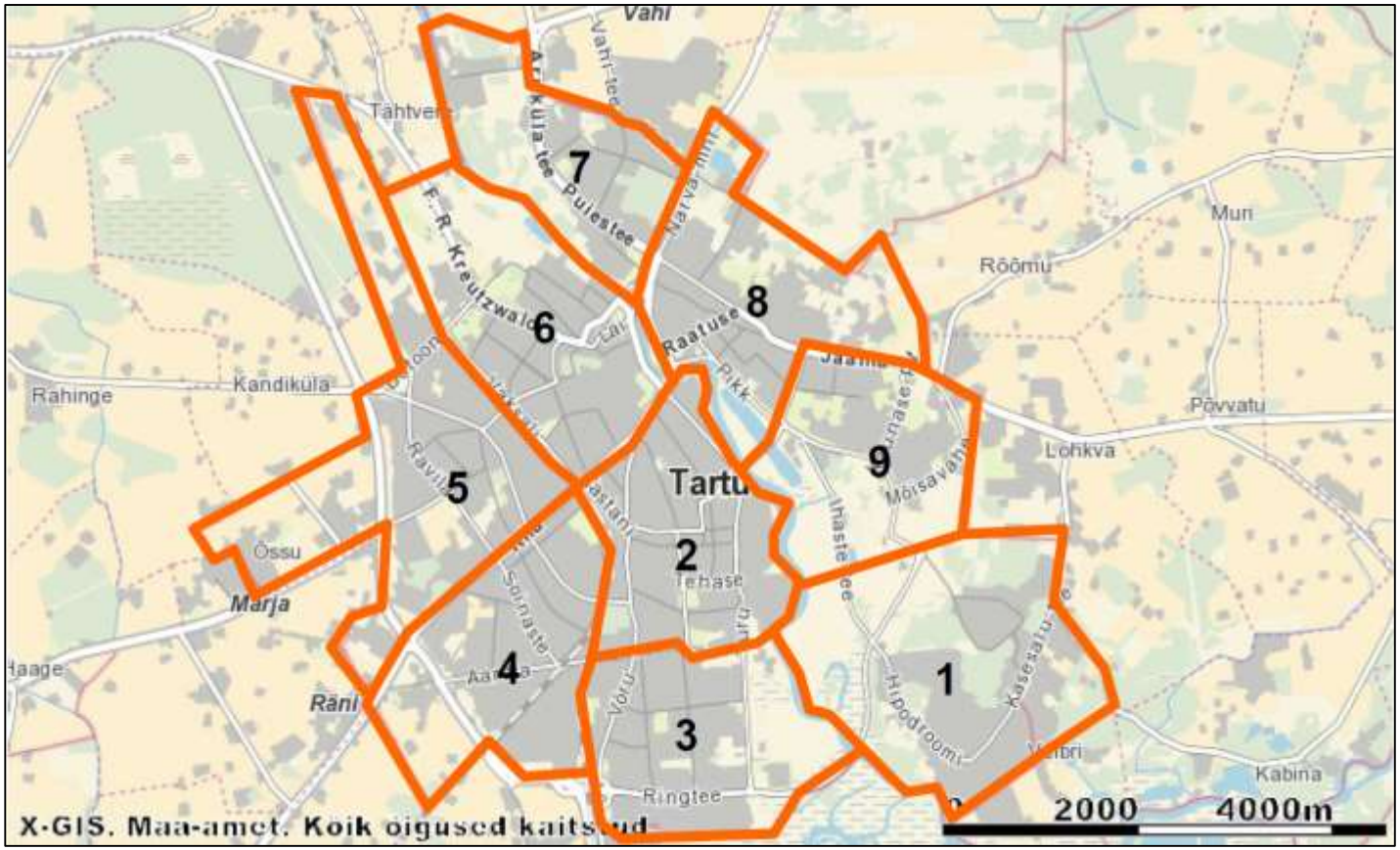
Public buildings in 2020

Large scale renovation works in 2016 to 2020:
- 1 new kindergarten
- 1 new stadium building
- 1 new wing to an existing kindergarten
- 2 fully renovated kindergartens
- 2 fully renovated schools

Additional activities:
- Procurement of energy efficient office equipment
- Fixing central heating issues in 2 administration buildings
- Renovation of kitchens in schools and kindergartens will increase electricity consumption
- Regular renovation works in administration buildings with installment of new LED lighting



Street lighting districts



Street lighting in 2020 and 2024

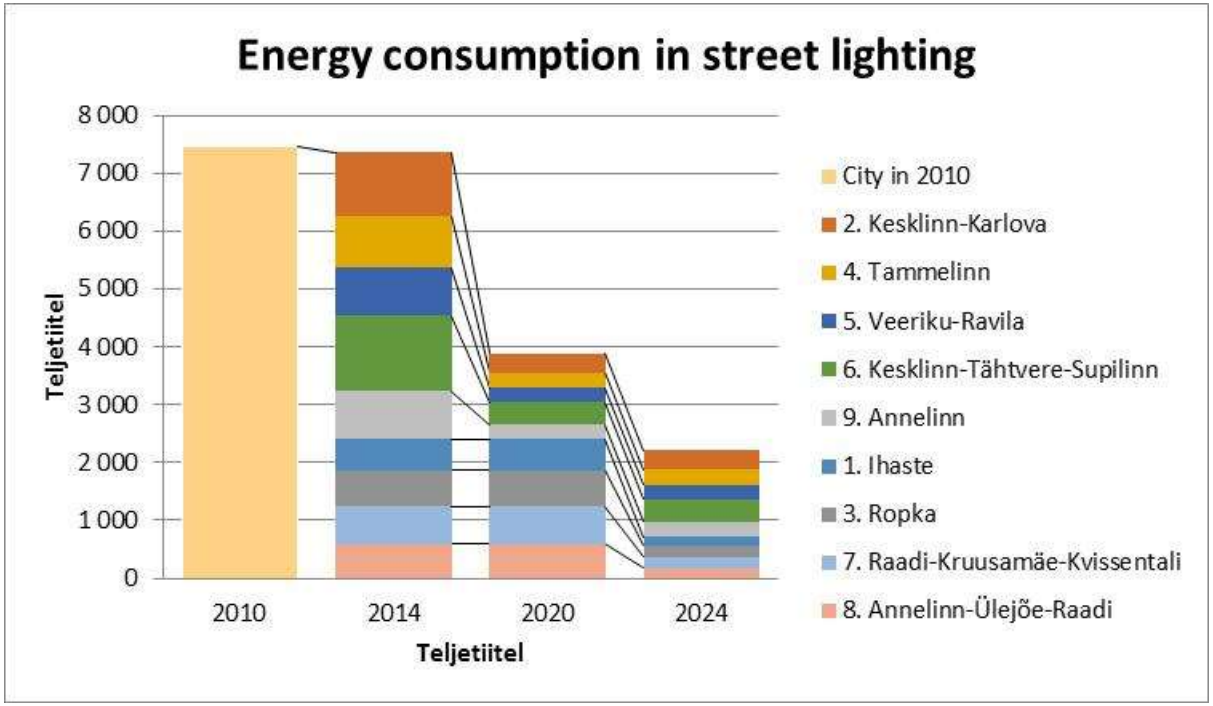
Replace one lighting district per year.

5 districts replaced by 2020

All districts replaced by 2024

Energy saving measures include:

- Replacement of HPS lights with LEDs
- Dimming of LED lights
- Motion sensors to control the light intensity
- Decoupling smaller streets from main streets
- Reconfiguration of switchboards
- Optimal use of dimming and motion sensors in main and side streets
- Gathering citizen feedback on perceived comfort and security level on streets with dimming options and motion sensors.



By 2020:

- Luminaries to be replaced: 7200 or 68%
- Energy consumption decrease: 48% or 3,57 GWh.

By 2024:

- Energy consumption decrease: 70% or 5,24 GWh.

Public transportation on 2020

The total distance traveled in 2010 - 3 600 000 km.

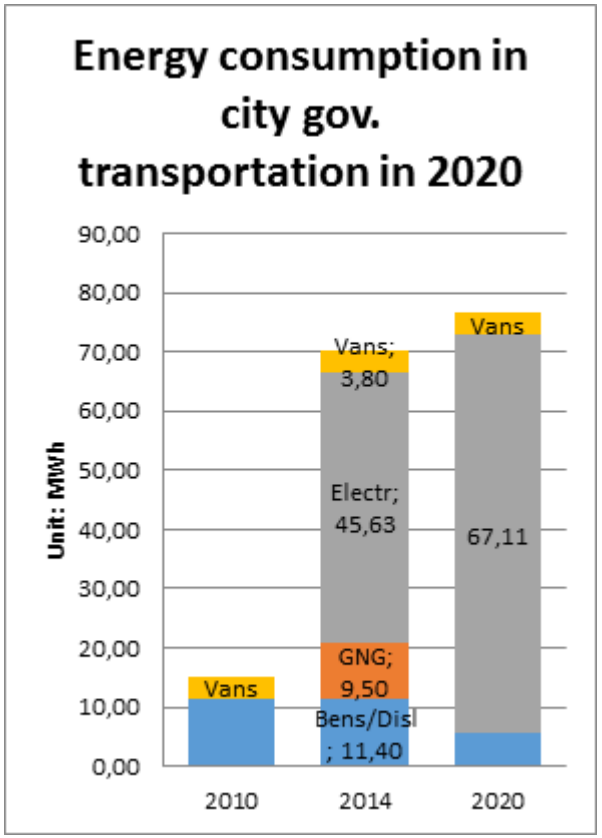
The total distance traveled in 2020 – 4 000 000 km.

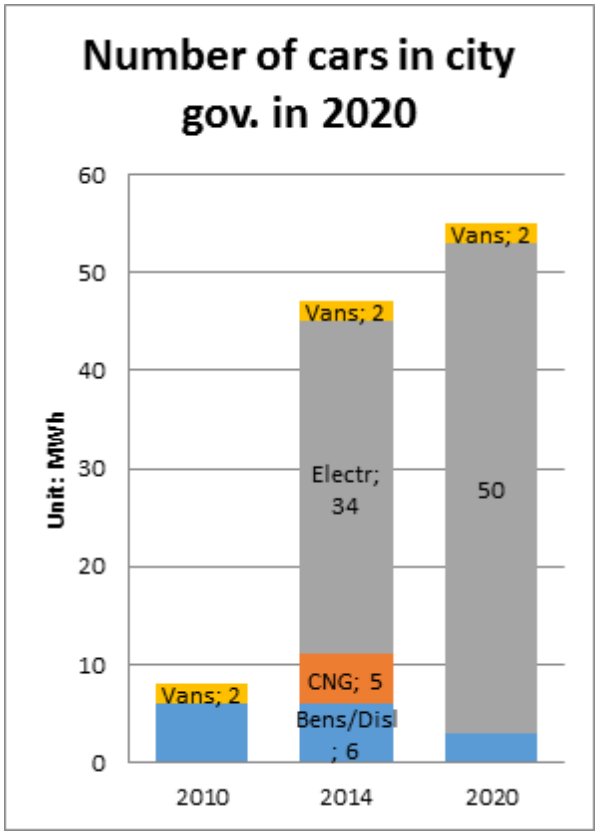
The city is extending its public transportation network to connect neighboring parishes to the city.

It is done to provide better service to people living in the area and to reduce private car use.

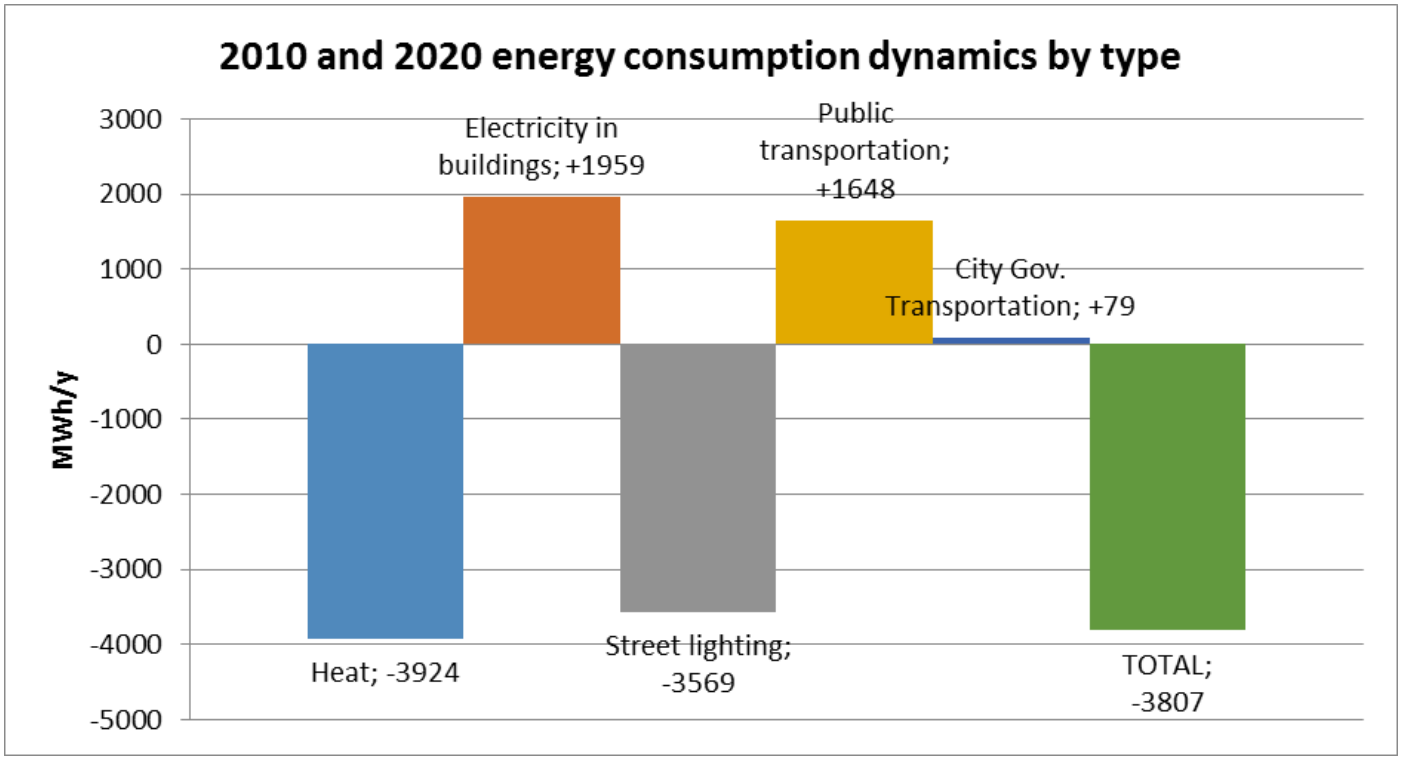
City gov transportation in 2020

- The quality of social services cannot decrease and the use of passenger cars will continue.
- The current gasoline and diesel cars will be replaced by CNG and electric vehicles.
- The current property management situation will be reformed by the year 2020 and it will create demand for extra 3 to 4 EV-s.





Tartu City Gov. Energy Consumption in 2020



Other measures

1. Energy management system
2. User education
3. Energy audit of sports facilities
4. Adaption of low-energy construction management system
5. Green procurements
6. Sustainable Tartu webpage
7. Project SmartEn City

Energy Efficiency Action Plan was approved by City Government on

23rd of February 2016

Thank you for your attention!

PLEEC

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