

TAKING
COOPERATION
FORWARD

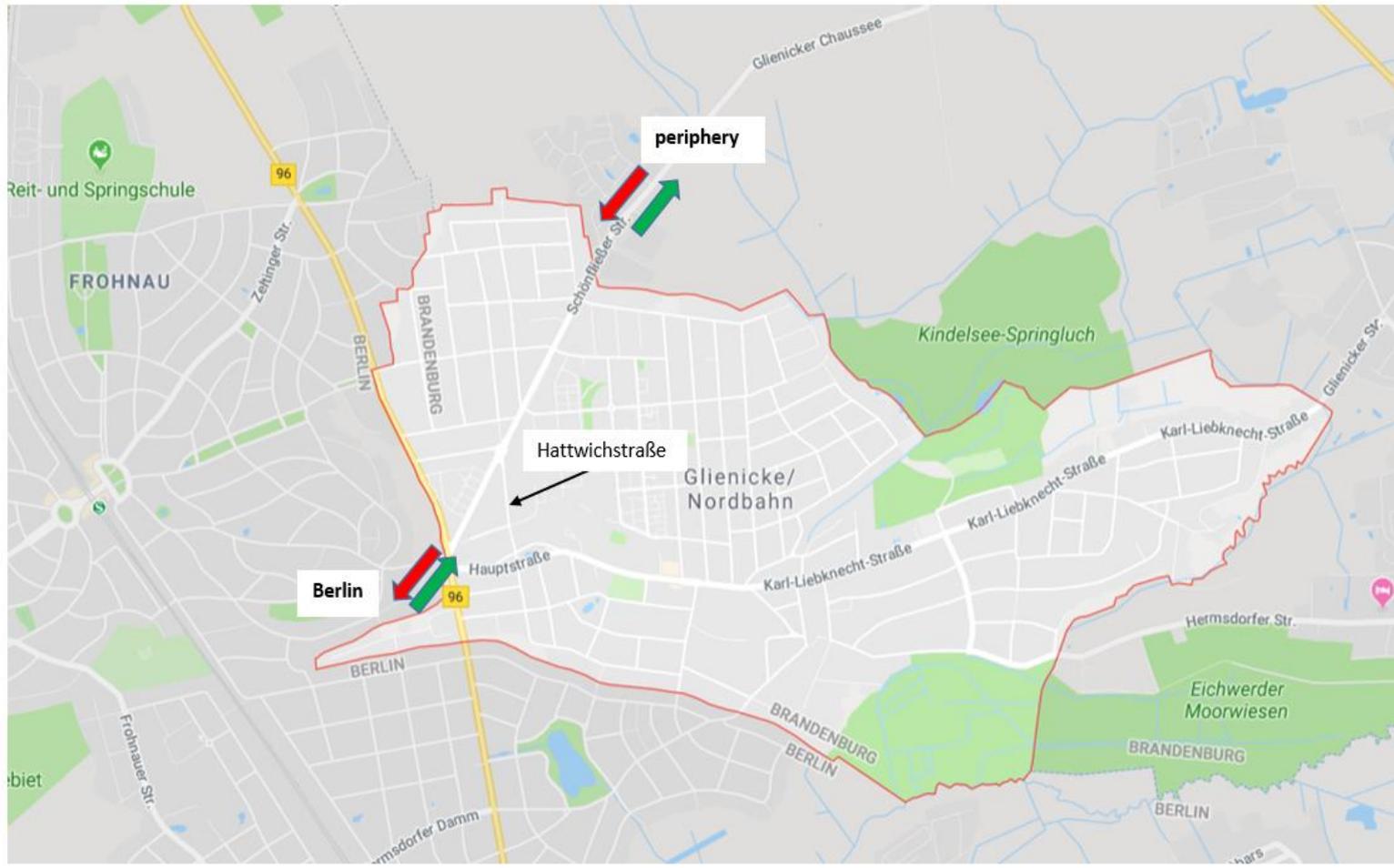


Using data for development of algorithms and use of sensors at the pilot project in Glienicke/ Nordbahn



Dr. Mehmet Yeni, André Körner SWARCO, WISMAR, 27.03.2019

geographical position of the pilot project



adaption section



- Extension of the pilot project with 17 LED luminaires to realise an adaptation section in the Schönfließer Straße (public bus line)
- Adaptation values between 50 % (north east) and 100 % (south west) of the actual lighting level in the Schönfließer Straße (minimum 33 % of new highest level)



USING DATA FOR DEVELOPMENT OF ALGORITHMS AND USE OF SENSORS AT THE PILOT PROJECT IN GLIENICKE/ NORDBAHN



Fire brigade

Gymnasium

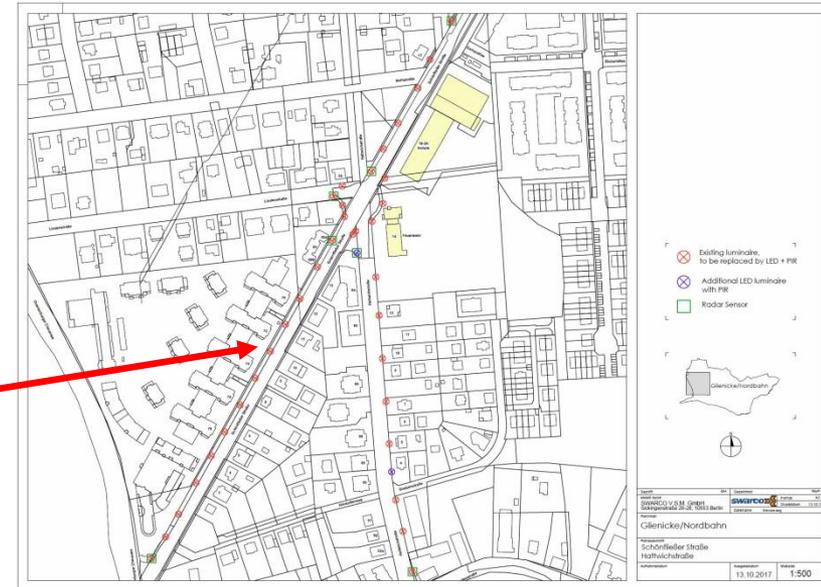
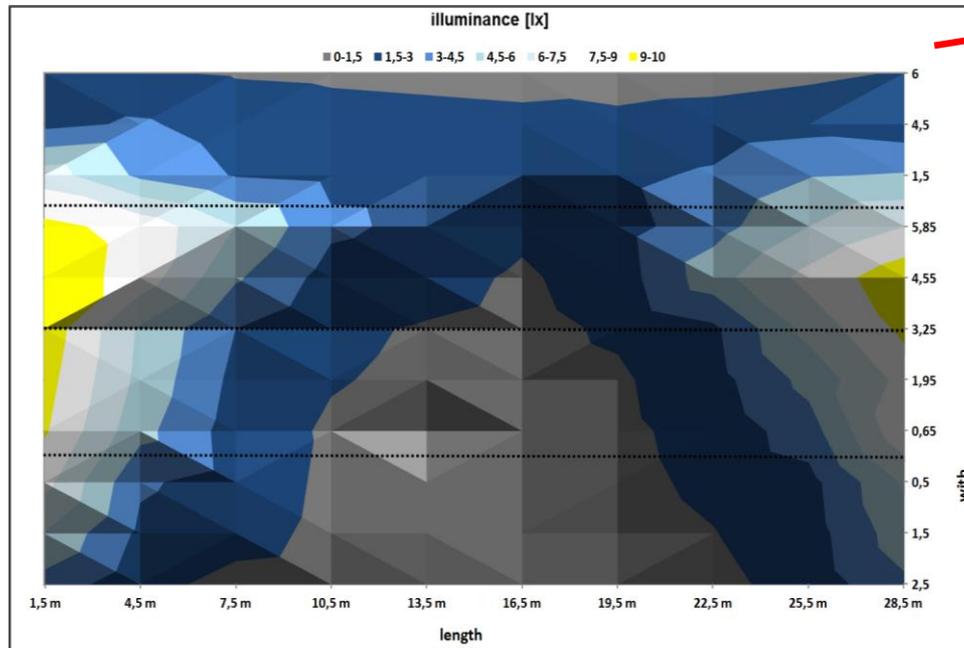
Arrays of detection



earlier lighting situation



Typical technical luminaire with 50 W HPS lamps



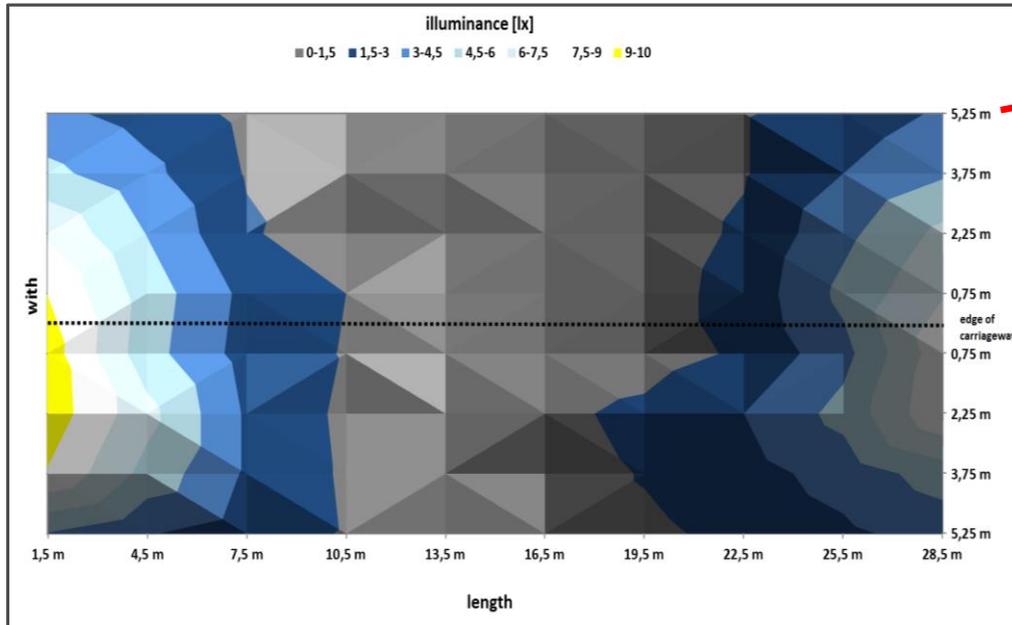
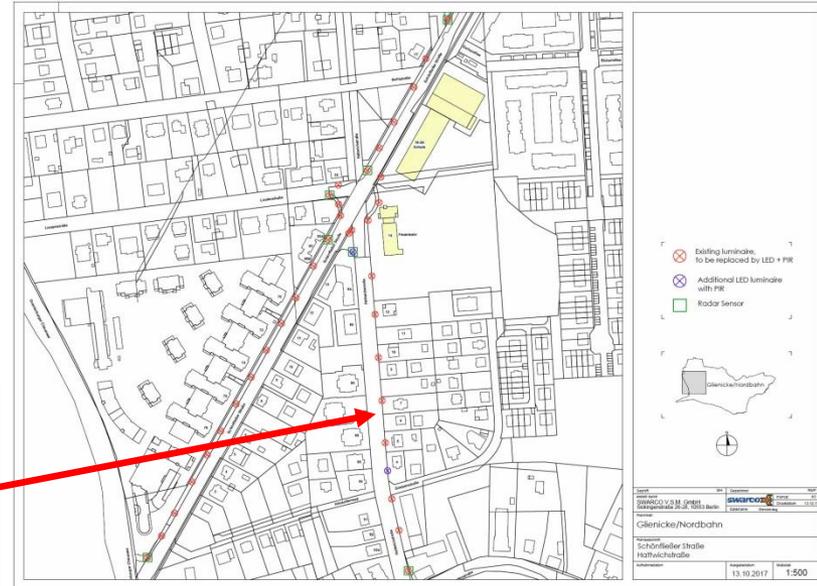
	road	Walkway 1	Walkway 2
E _{min} [lx]	0,7	0,6	0,8
E _{max} [lx]	10,7	8,0	6,8
E _{average} [lx]	4,7	2,3	2,4
U ₀	0,15	0,26	0,33
U ₁	0,06	0,08	0,12



earlier lighting situation



Typical technical luminaire with 70 W HPS lamps



	road	Walkway 1
E _{min} [lx]	0,6	0,4
E _{max} [lx]	9,9	9,0
E _{average} [lx]	2,5	3,3
U ₀	0,18	0,16
U ₁	0,04	0,01



selected led luminaires



luminaires typ 1

leds: 43 pcs. high power leds
connected wattage max: 88,7 W
luminous flux max: 10.500 lm

luminaires typ 2

leds: 12 pcs. high power leds
connected wattage max: 44,8 W
luminous flux max: 5.100 lm



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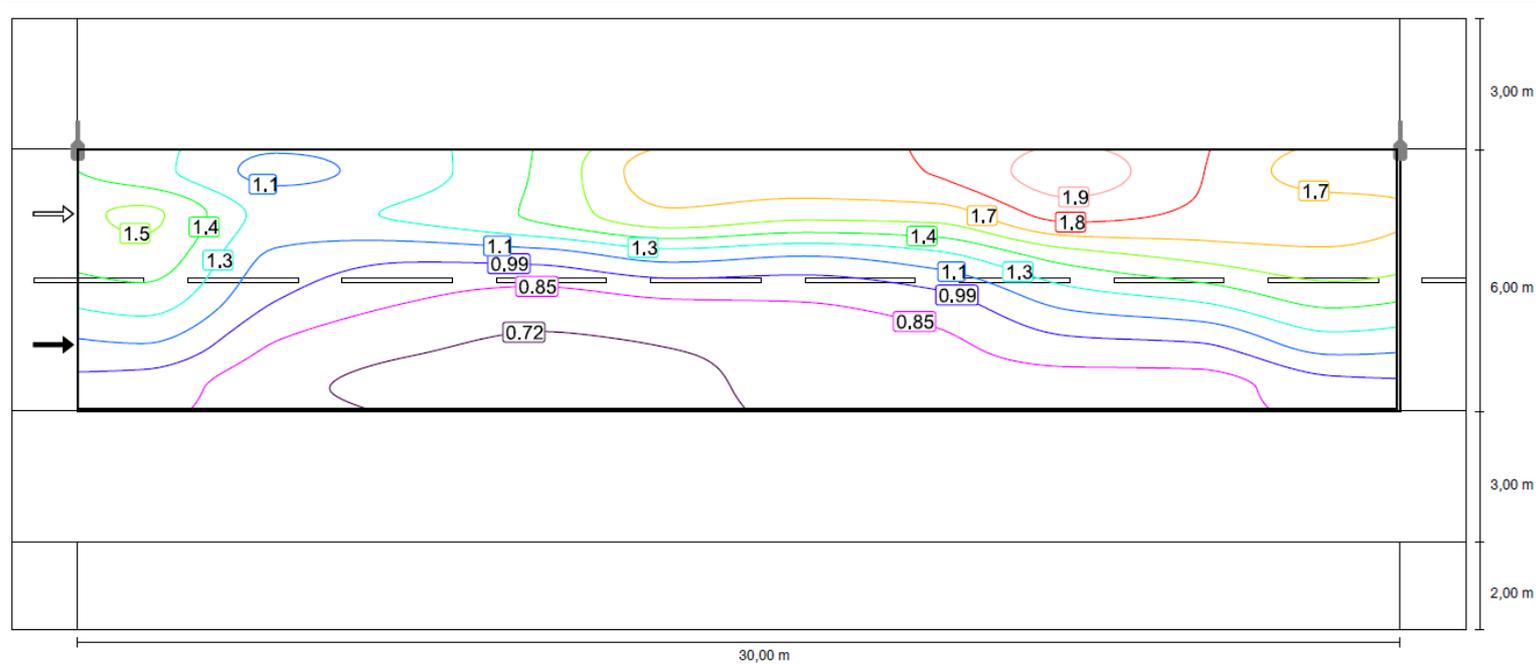
Hattwichstraße



Schönfließer Straße
TAKING COOPERATION FORWARD



the new lighting situation (Schönfließer Straße)



I_{ledmax} : 600 mA

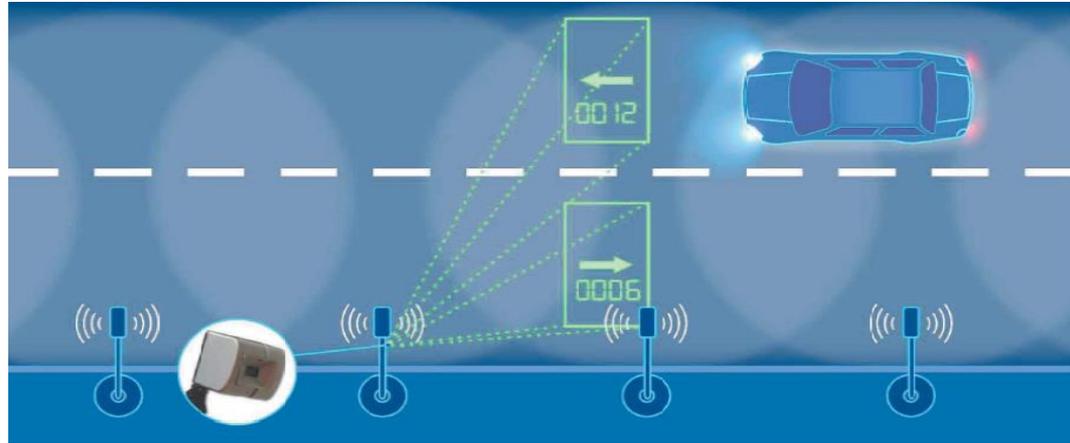
L_m : 1,11 cd/m² (111 % of standard value M3), L_{min} : 0,6 cd/m², U_0 : 0,54

E_m : 19,2 lx

- case of emergency: maximum value I_{led} = 600 mA
- minimal level: 33 % of standard lighting level



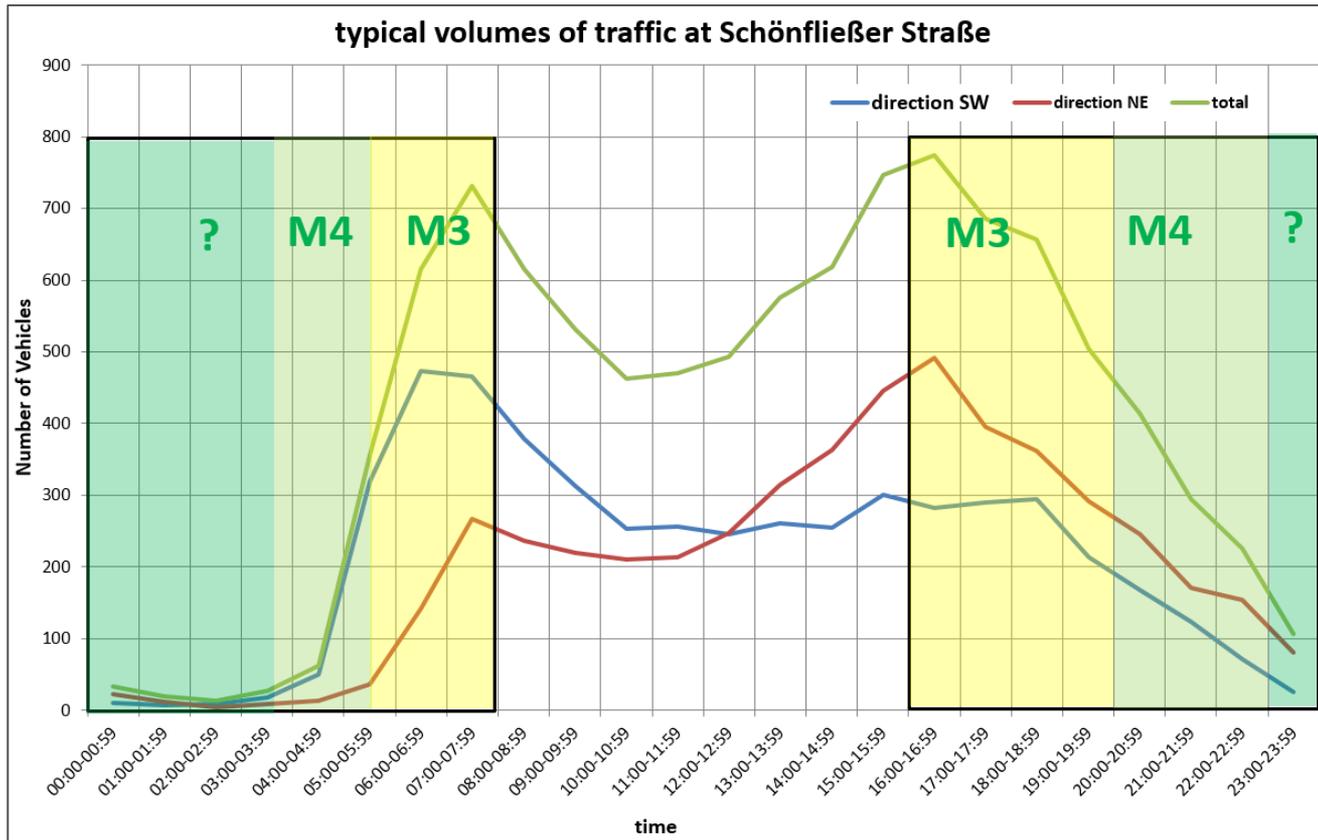
Used sensor/ camera



- sensors can identify vehicles, pedestrians and cyclists
- several detection fields can be used
- cameras allow the detection of several lanes of a roadway or the simultaneous detection of the carriageway and oncoming lane
- statistical collection of traffic data are automated, so that no further analysis tools are needed
- only necessary to specify the quantities which lighting levels are to be generated as system responses for the detected traffic volumes.



dimming level vs. traffic density



to be defined:
100 % DIN EN 13201:
lighting class at main
traffic time:

M3: 1,0 cd/m²

lighting class at night time:

M4: 0,75 cd/m²



traffic density and DIN EN 13 201

Haupt-Wettertyp	Bauliche Maßnahmen zur Verkehrs-beruhigung	Kreuzungsdichte Kreuzungen/km	Schwierigkeit der Fahraufgabe	Verkehrsfluss Kraftfahrzeuge je Tag					
				< 7 000			≥ 7 000		
				←	o	→	←	o	→
trocken	nein	< 3	normal	ME5	ME5	ME4b	ME4b	ME4b	ME3c
			höher als normal	ME4b	ME4b	ME3c	ME4b	ME4b	ME3c
		≥ 3	normal	ME4b	ME3c	ME2	ME3c	ME3c	ME2
			höher als normal	ME3c	ME3c	ME2	ME3c	ME3c	ME2
ja	Auswahl wie oben, jedoch nur im Bereich der verkehrsberuhigten Flächen Leuchtdichteniveau um eine Stufe erhöhen ^a								
nass	Auswahl wie oben, jedoch MEW-Klassen								

^a Wenn die Leuchtdichte als Auslegungskriterium nicht anzuwenden ist, kann die Beleuchtungsstärke verwendet werden. Zu den empfohlenen ME-Klassen vergleichbare CE-Klassen werden in Tabelle 3 angegeben.

to be defined:
100 % DIN EN 13201:
lighting class at main
traffic time:

M3: 1,0 cd/m²

lighting class at night time:

M4: 0,75 cd/m²

Klasse	Fahrbahnleuchtdichte bei trockener bzw. nasser Straßenoberfläche				Physiologische Blendung trockene Zustände f_{TI}^c [Höchstwert] %	Beleuchtung der Umgebung trockene Zustände R_{EI}^d [Mindestwert]
	trockene Zustände			nass		
	\bar{l} [Minimaler Wartungswert] cd·m ² N1	U_o [Mindestwert]	U_1^a [Mindestwert]	U_{ow}^b [Mindestwert]		
M1	2,00	0,40	0,70	0,15	10	0,35
M2	1,50	0,40	0,70	0,15	10	0,35
M3	1,00	0,40	0,60	0,15	15	0,30
M4	0,75	0,40	0,60	0,15	15	0,30
M5	0,50	0,35	0,40	0,15	15	0,30
M6	0,30	0,35	0,40	0,15	20	0,30



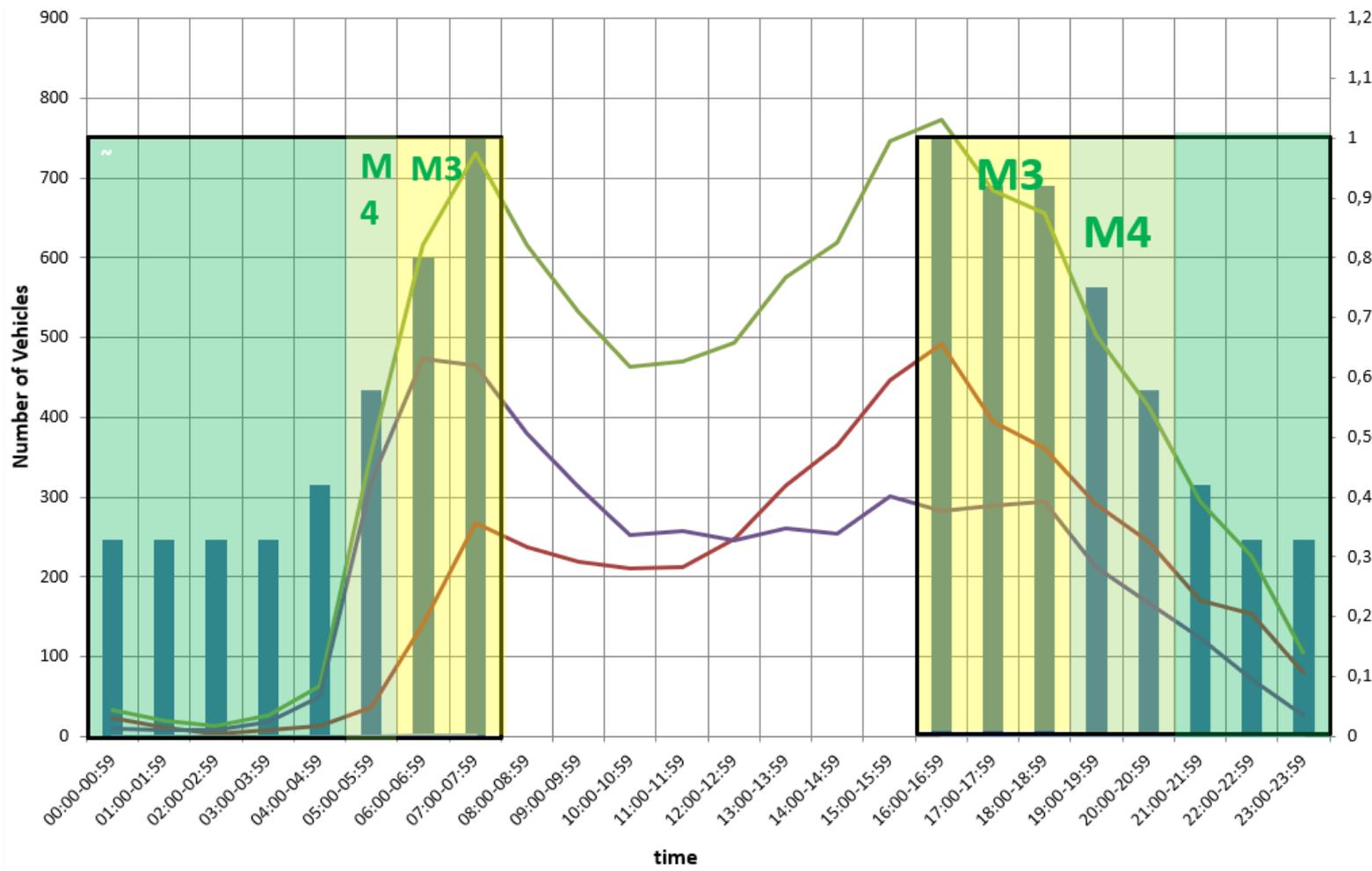
development of algorithms

Control step	count of vehicle	ILED [mA]	L [cd/m ²]	lighting class
1	danger situation	600	1,11	max
2	18000	540	1,00	M3
3	14300	500	0,93	M3
4	10600	450	0,83	M3
5	7000	410	0,75	M4
6	5500	360	0,67	M4
7	4000	320	0,59	M4
8	2500	270	0,50	M5
9	1000	230	0,43	M5
10	500	180	0,33	M6
11	non trafic	180	0,33	min (M6)

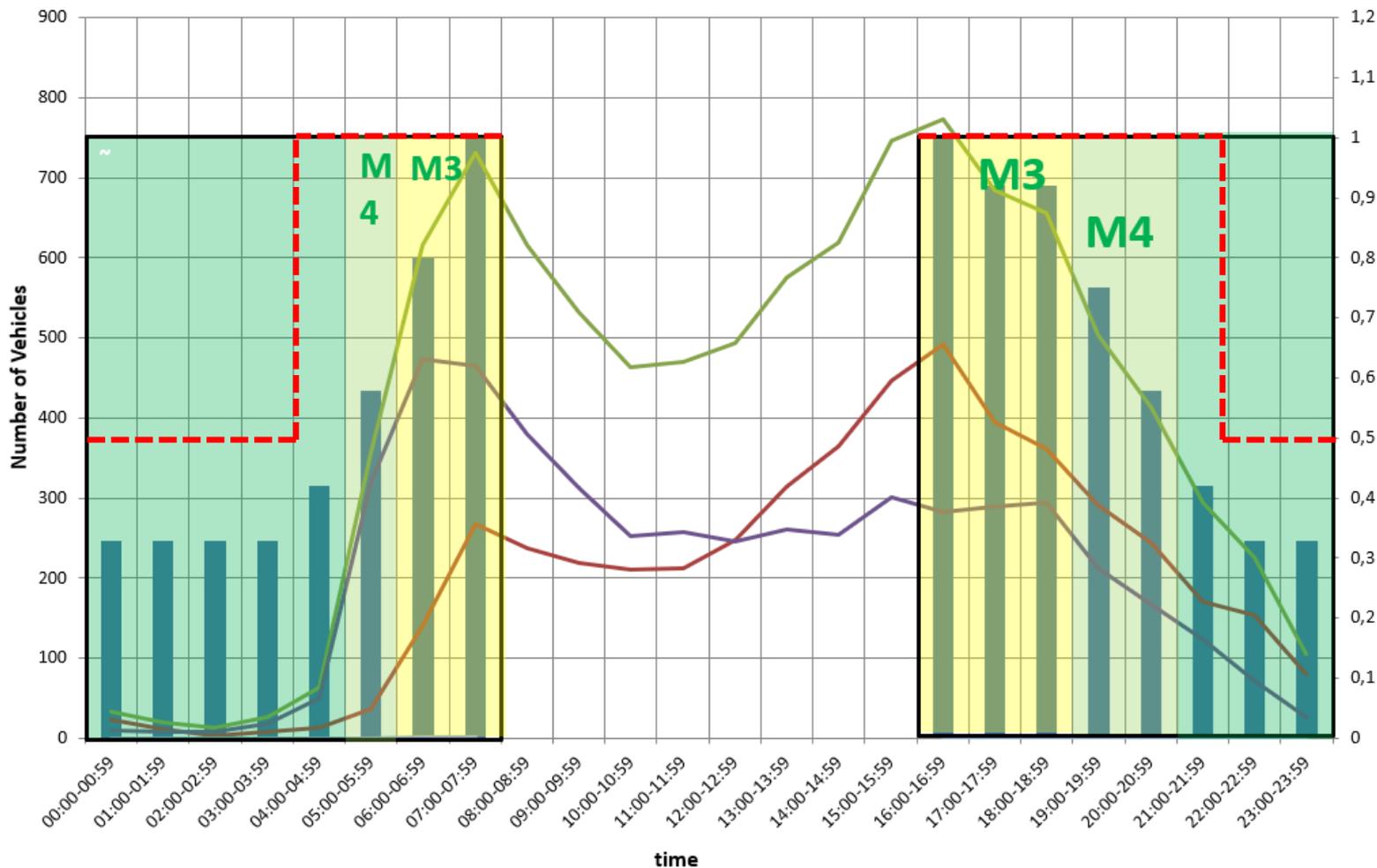
- equidistant intermediate stages in each lighting class of lighting levels
- proportionality between led current and luminance
- number of vehicle as **determining value**
- led current as **system answer**
- **data integration 15 min**
- **fall-back scenario static dimming between 22-05 h (50 %)**



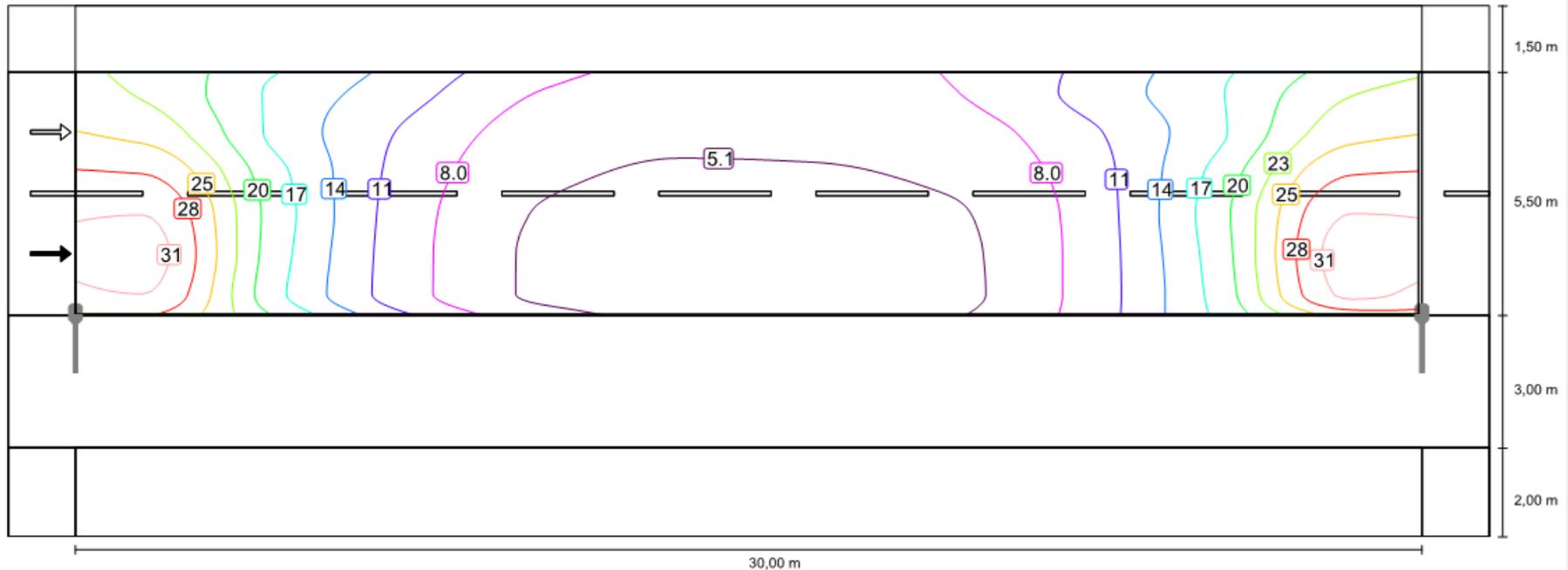
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energy saving potentials



the new lighting situation (Hattwichstraße)



Iledmax: 600 mA

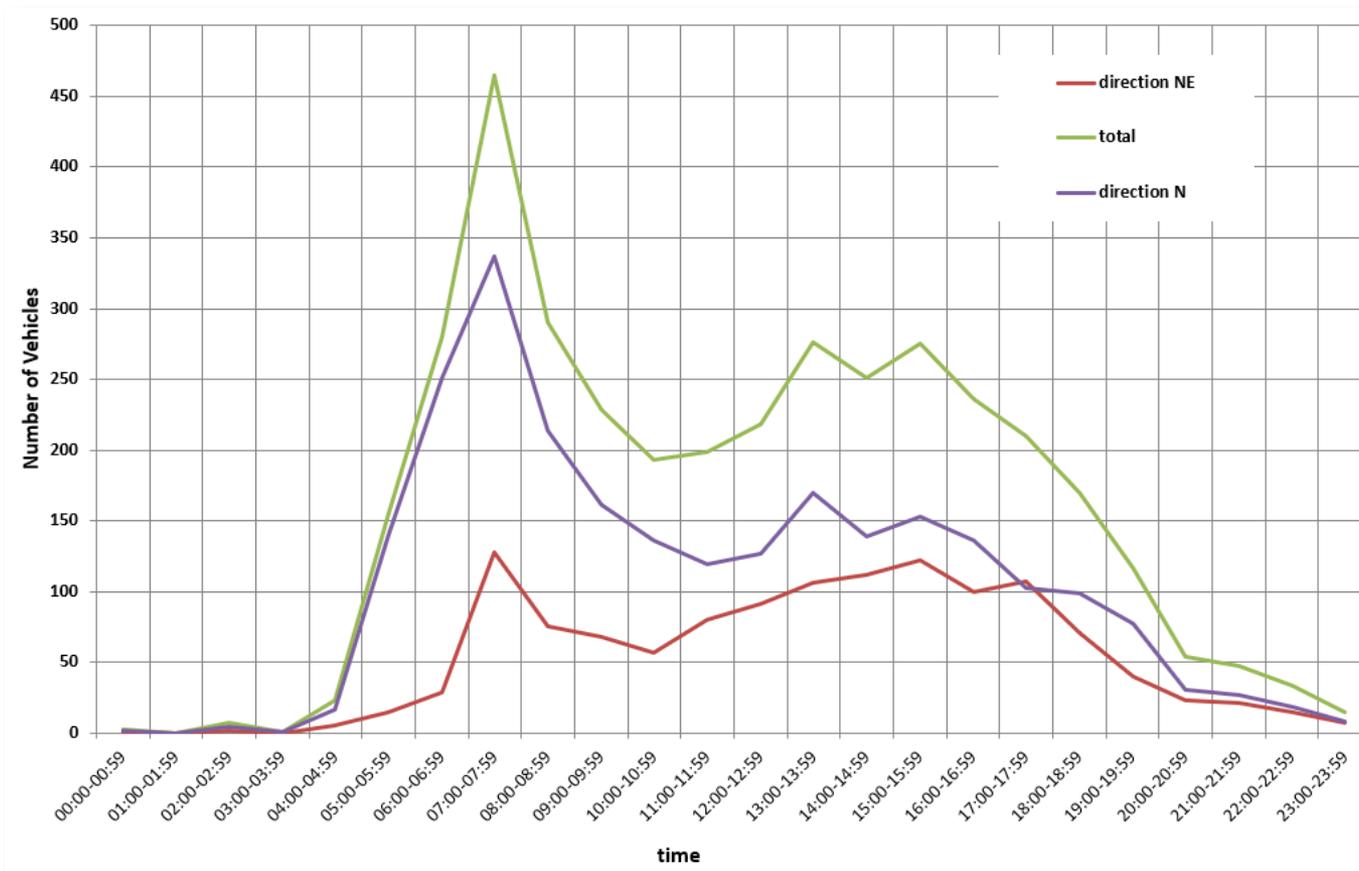
Em: 13,2 lx (111 % of standard value P3)

Emin: 3,6 lx

- case of emergency: maximum value Iled= 600 mA
- minimal level: 33 % of standard lighting level



Hattwichstraße dimming level vs. traffic density



DIN EN 13201:
lighting class: **P3**
Em: **7,5 lx**
Emin: **1,5 lx**

VoT: 4.000 vehicles
per day
21h-6h: 15 %
0 h- 4 h: 90 vehicles



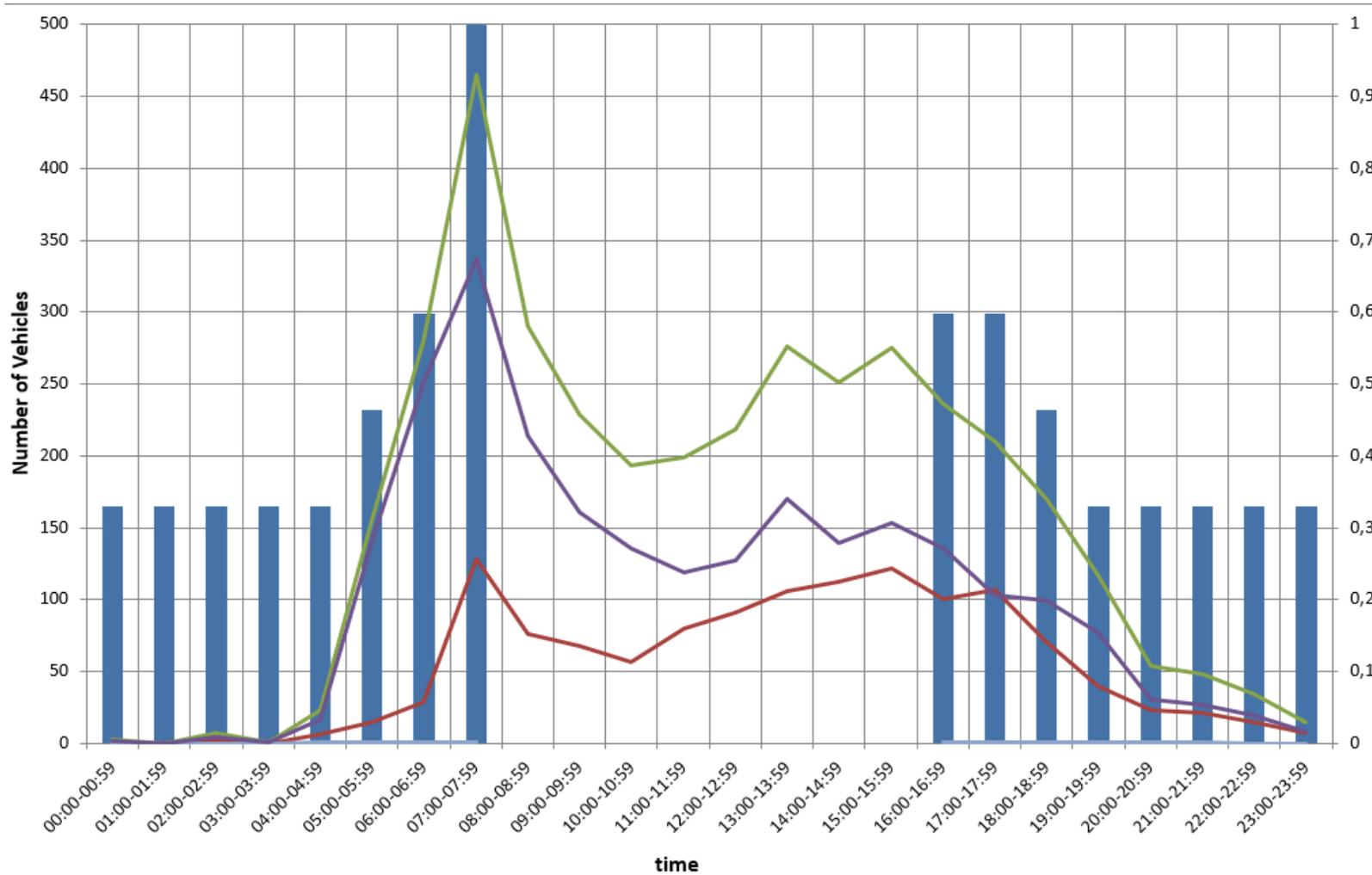
development of algorithms

Control step	count of vehicle	ILED [mA]	Em [lx]	Em [%]	lighting class
1	danger situation	600	13,20	175	max
2	7000	350	7,50	100	P3
3	5000	303	6,50	87	P3
4	3000	256	4,50	60	P3
5	1000	162	3,50	47	P3
6	<500	115	2,50	33	min

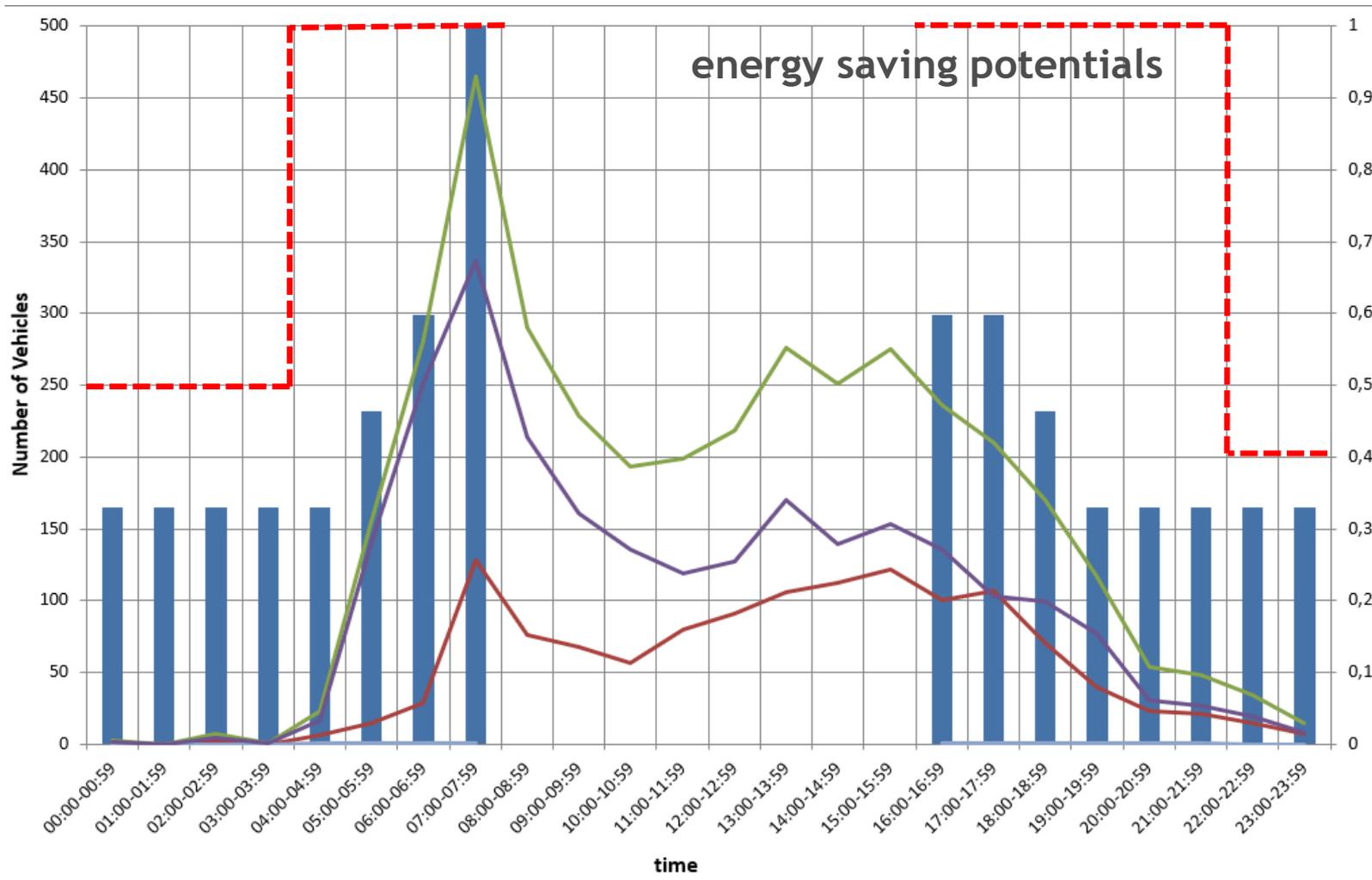
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- proportionality between led current and luminance
- number of vehicle as **determining value**
- led current as **system answer**
- **fall-back scenario static dimming between 22-05 h (50 %)**



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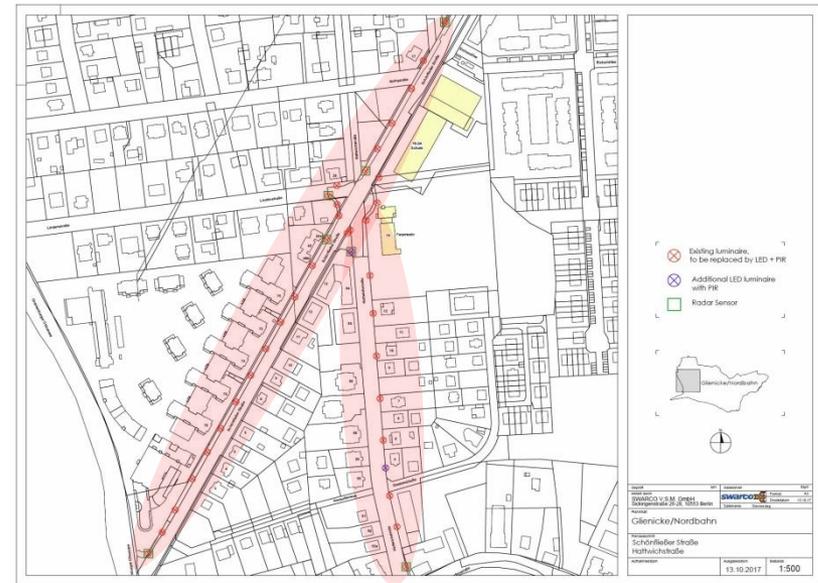
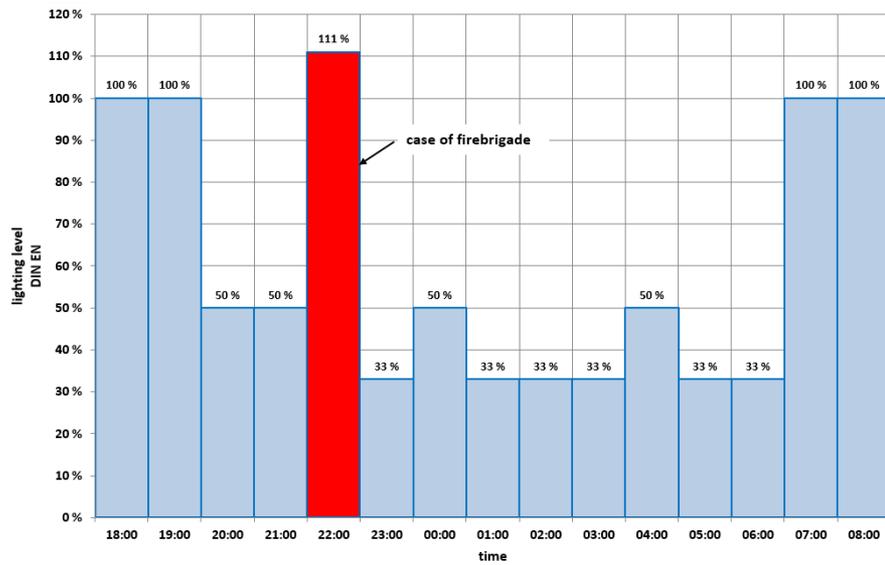


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Variable algorithms

dimming level vs. case of emergency (fire brigade)



- in case of emergency 100 % of total lighting level of luminaires
- sleep mode of detection = current mode of traffic density mode
- cleared: no detection direct signal from the fire brigade, hold time for higher level: 30 min



summary

- 55 LED luminaires in total, 36 of which as exchange for existing luminaires with conventional technology, 2 new ones to avoid dark areas and increase uniformity (installed)
- extension of the pilot installation with 17 LED luminaires to realise an adaptation section at Schönfließer Straße along the public bus line
- camera detection of VoT at entrance and exit of pilot streets, including a roundabout
- special detection for the fire brigade area



forecast

- several detection periods are to test with the goal to define best practice for detections and system answer models for both street types
- energy saving potentials during different night periods will be measured and documented exactly
- public acceptance will be analysed, the acceptance of the fire brigade and school management especially of interest
- interests in collected data will be explained (city of Glienicke/ Nordbahn other parties)
- practice experiences of maintenance considerations and lighting quality indicators expected
- use of environmental sensors additionally planned by the city



Thanks a lot
for your attention!



- concept developed further, now sensors are determined
- predetermining of the traffic volumes at both streets
- pre testing of telemanagement system completed
- discussions with the city, fire brigade and school administration about the using of cameras (data privacy!!!)
- installation of street detection and telemanagement system completed
- test of sensors on going

