



**UNECE**

**Working Party on Road Transport  
(114th session)**

**PCO Report on TEM Project deliverables**

Geneva, 16 - 18 October 2019

# Agenda

- **Report on Business models for road sub-sector in TEM Region (B1/B3) - *delivered in 2019***
  - It describes how road infrastructure has become an essential part of daily life. Individual road users, logistic companies or public transportation agencies expect reliable and safe road infrastructure to carry out their transportation or wider mobility operations, moving goods and people.
  - Road authorities need to properly plan, build, maintain and operate the road infrastructure to create given above value for its customers.
  
- **Report on Maintenance Service Levels for TEM Network (C1) - *delivered in 2019***
  - It include existing standards, together with models for financing of road maintenance. Guidelines for maintenance of roads and motorways describe technical aspects of all road elements and its maintenance procedures.

# Agenda

- **Report on Asset Management System Tools for Roads (C2) – *to be delivered in the first quarter of 2020***
- analysis of the scope of Asset Management Systems (AMS) and its impact on the road authorities and its business processes (especially life-cycle management processes), maturity assessment methodology in terms of Asset Management and deployment approaches and strategies.
- **Report on BIM for infrastructure in the context of the government road administration (D2) - *to be delivered in 2019***
- focus of the Report should be on analysis of the scope of BIM/CIM and its impact on the road authorities and its business processes (especially life-cycle management processes), maturity assessment methodology in terms of BIM/CIM and deployment approaches and strategies
- **Report on Tolling systems deployment: considerations and recommendations (B2) - *to be delivered in 2019***
- Implementation of Electronic Tolling Systems (ETS) may be considered as a tool which enable achievement of strategic goals and objectives in the country's economy and its transport sector.

# TEM Backbone Network Report

- As for now introductory section of the Report consists of:
  - Executive Summary and Project overview
  - Depiction of TEM Network and AGR
  - Information about key stakeholders initiatives in terms of network:
    - TEN-T
    - EATL
    - Three Seas Initiative
    - 16+1 Initiative
  - Information about participating countries in the current edition

# TEM Backbone Network Report

## Essential part

- Economic data for TEM Member Countries
  - Transport growth evolution
  - Modal split of inland freight transport
  - Employment by transport mode
  - Gross investment spending in road infrastructure
  - Maintenance expenditures
  - Registered vehicles by type

# TEM Backbone Network Report

General economic data (example: goods transport)

Goods transport on national territory by road by Type of goods transport, Topic, Country and Year, Tonne-kilometres (millions)					
	2012	2013	2014	2015	2016
Armenia	513	641	726	479	676
Austria	<b>16143</b>	<b>15524</b>	<b>16605</b>	<b>17161</b>	<b>18091</b>
Bosnia and Herzegovina	<b>2301</b>	<b>2658</b>	<b>3216</b>	<b>3405</b>	..
Croatia	<b>8649</b>	<b>9133</b>	<b>9381</b>	<b>10439</b>	<b>11337</b>
Czechia	<b>51228</b>	<b>54893</b>	<b>54092</b>	<b>58714</b>	<b>50315</b>
Georgia	637	646	655	664	674
Greece	20839	18970	19223	19764	20903
Italy	124016	127241	117813	116820	112639
Lithuania	<b>23449</b>	<b>26338</b>	<b>28067</b>	<b>26485</b>	<b>30974</b>
Poland	<b>222332</b>	<b>247594</b>	<b>250930</b>	<b>260713</b>	<b>290749</b>
Romania	29662	34026	35135	39022	..
Slovakia	29504	30005	31304	33525	36106
Slovenia	15888	15905	16273	17912	18714
Turkey	<b>216123</b>	<b>224048</b>	<b>234492</b>	<b>244329</b>	..



# TEM Backbone Network Report

General economic data (example: passenger transport)

Passenger Transport on National Territory by Passenger-kilometres (millions), Country and Year, Total km Passengers					
	2012	2013	2014	2015	2016
Armenia	2611	2599	2536	2396	2437
Austria	85369	86132	..	..	..
Bosnia and Herzegovina	1925	1764	1665	1690	..
Croatia	30586	30859	30962	31171	31455
Czech Republic	78719	79382	..	84829	87257
Georgia	6219	6393	6572	6756	6945
Greece	..	..	..	..	..
Hungary	51793	..	..	..	..
Lithuania	37257	36451	27486	27781	28674
Poland	232456	235205	240068	241853	244511
Romania	16901	17082	18339	17471	..
Slovakia	5212	5115	5304	5804	5987
Slovenia	..	..	..	..	..
Turkey	258874	268168	276073	290734	300852

# TEM Backbone Network Report

## Essential part

- Structure of the national TEM Members network
  - Road Network data:
    - E-Road network in total (2016)
    - Road network density by country (km roads/km<sup>2</sup> land area) (2014/2015)
    - Traffic density by country (AADT) (2015)
  - General Transport Data
    - Road passenger transport (pkm) (2016)
    - Roads good transport (tkm) (2016)
    - Vehicle-kilometers (vkm) (2015/2016)
  - Road Safety
    - Accidents by country (2016)
    - Fatalities and injuries by country (2016)
    - Fatalities by country (2016)
    - Fatalities by country by 1 milion population (2016)



# Examples

Total road network (KM), 2016	Road Network total (km)	Motorways (km)
Armenia	n/a	n/a
Austria	12286	1719
Bosnia and Herzegovina	21 846	n/a
Bulgaria	19162	740
Croatia	25444	1310
Czech Republic	129433	1222,661
Georgia	n/a	n/a
Italy	252073	6943
Lithuania	83415	314
Poland	420236	1640
Romania	85333	747
Slovakia	44007,7	463,2
Slovenia	38178	773
Turkey	240048	2542

# Examples

Traffic density by country AADT, 2015	
Armenia	n/a
Austria	2241,1
Bosnia and Herzegovina	n/a
Bulgaria	n/a
Croatia	2325
Czech Republic	2642
Georgia	1603
Italy	n/a
Lithuania	1602,3
Poland	5158
Romania	6189,9
Slovakia	1521
Slovenia	587,2
Turkey	9353

# Examples

Accidents by country	
Armenia	3399
Austria	38466
Bosnia and Herzegovina	35725
Bulgaria	7404
Croatia	10779
Czech Republic	21286
Georgia	6939
Italy	175791
Lithuania	3213
Poland	33664
Romania	30751
Slovakia	5602
Slovenia	6495
Turkey	185128

# Examples

## Fatalities by country

Armenia	346
Austria	432
Bosnia and Herzegovina	334
Bulgaria	708
Croatia	307
Czech Republic	611
Georgia	581
Italy	3283
Lithuania	192
Poland	3026
Romania	1913
Slovakia	275
Slovenia	130
Turkey	7300



# TEM Backbone Network Report

## Essential part

- Structure of the TEM Backbone Network
  - Road Network data of TEM Network:
    - Length in km
    - In operation in km
    - Under construction in km
    - Planned in km
    - AADT volume

# Examples

Length in km	
Armenia	n/a
Austria	466,7
Bosnia and Herzegovina	1430,777
Bulgaria	1083,90
Croatia	1718,3
Czech Republic	975
Georgia	n/a
Italy	n/a
Lithuania	725
Poland	6027
Romania	n/a
Slovakia	n/a
Slovenia	n/a
Turkey	3764

# Examples

Under construction (km)			
	Cost (mil. Euro)		Number of km
Armenia	n/a		n/a
Austria	0		0
Bosnia and Herzegovina	1550		45,8
Bulgaria	1115		372,4
Croatia	496,4		62,6
Czech Republic	582		38
Georgia	n/a		n/a
Italy	n/a		n/a
Lithuania	n/a		n/a
Poland	13929,1		1434,0
Romania	n/a		n/a
Slovakia	n/a		n/a
Slovenia	n/a		n/a
Turkey	n/a		869

# Examples

AADT on TEM Network	
Armenia	n/a
Austria	63707
Bosnia and Herzegovina	8754
Bulgaria	15136
Croatia	13253
Czech Republic	38074
Georgia	n/a
Italy	n/a
Lithuania	10504
Poland	40266
Romania	n/a
Slovakia	n/a
Slovenia	n/a
Turkey	34304
<b>Average for whole network</b>	<b>26666</b>



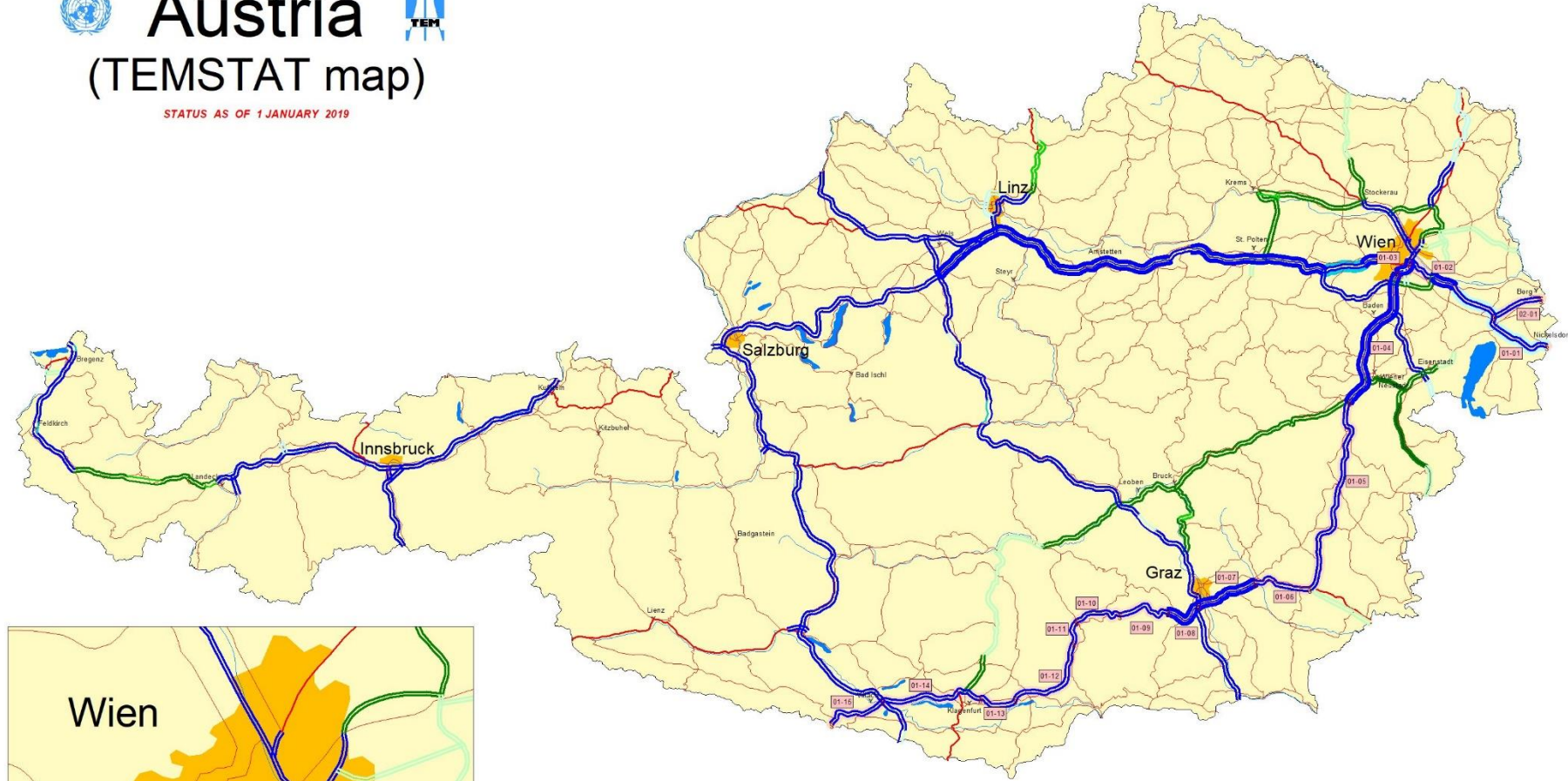


# Austria

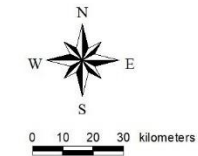
## (TEMSTAT map)



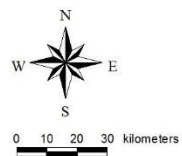
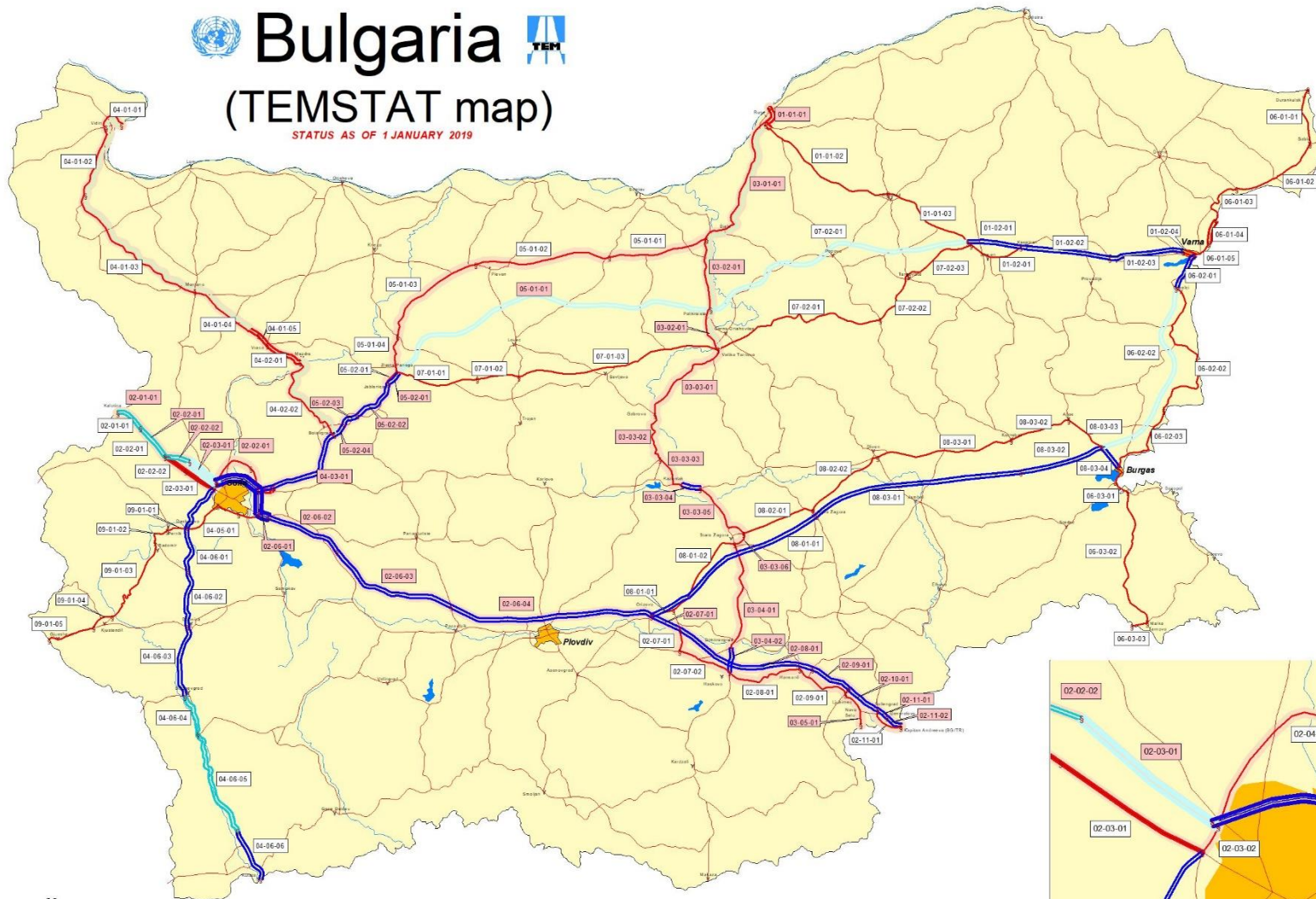
STATUS AS OF 1 JANUARY 2019








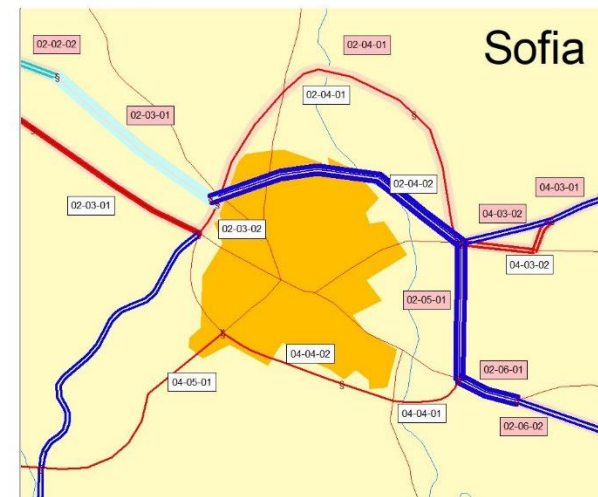
No. of TEM subsection		TEM, motorway and expressway network	
	City		Motorway - in operation
	Town		dual three-lane (2x3) or more (TEM only)
	Lake		dual two-lane (2x2) and other motorways
	River		single carriageway - 4 traffic lanes or more (left or right)
			Motorway - under construction
			dual three-lane (2x3) or more (TEM only)
			dual two-lane (2x2)
			Motorway - programmed or planned
			dual two-lane (2x2)
			Expressway - in operation
			dual two-lane (2x2)
			single carriageway - 4 traffic lanes or more
			Expressway - under construction
			dual two-lane (2x2)
			Expressway - programmed or planned
			dual two-lane (2x2)
			single carriageway - 4 traffic lanes or more
			E - Road
	TEM road section		Other main roads
	TEM road section		Section limit
	TEM road section		TEM network and corridor



 **Bulgaria**   
**(TEMSTAT map)**  
STATUS AS OF 1 JANUARY 2019



 01-01-01	No. of contemporary road subsection	<b>TEM, TINA and E - network</b>	<b>Expressway - programmed or planned</b> dual two-lane (2x2)
 01-01-01	No. of TEM subsection		
	City	<b>Motorway - in operation</b> dual three-lane (2x3) or more dual two-lane (2x2) single carriageway - 2 or 3 lanes (left or right)	<b>Other main road</b> § Section limit  TEM network and corridor
	Town	<b>Motorway - under construction</b> dual two-lane (2x2)	
	Lake	<b>Motorway - programmed or planned</b> dual three-lane (2x3) or more dual two-lane (2x2) single carriageway - 2 or 3 lanes (left or right)	
	River		









































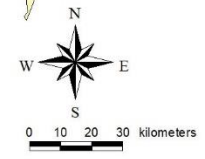


(TEMSTAT map)

STATUS AS OF 1 JANUARY 2019



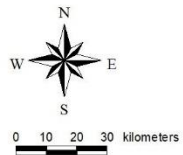
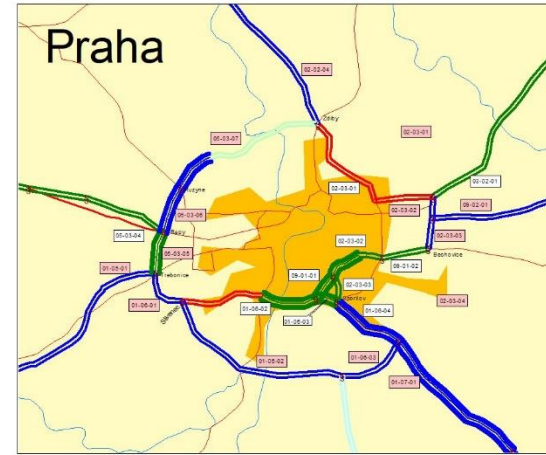
	No. of contemporary road subsection	<b>TEM, TINA and E - network</b>		<b>E - Road</b>		
	No. of TEM subsection	<b>Motorway - in operation</b>			dual two-lane (2x2) or more	
	City				single carriageway - 4 traffic lanes or more	
	Town				single carriageway - 2 or 3 lanes	
	Lake	<b>Motorway - under construction</b>			Other main roads	
	River				§ section limit	
		<b>Motorway - programmed or planned</b>				TEM network and corridor
						
						
						
						
						




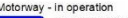
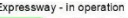


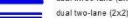
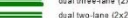


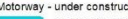
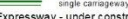
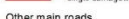

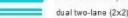

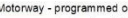
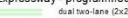


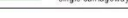





# Czech Republic

## (TEMSTAT map)

STATUS AS OF 1 JANUARY 2019



 05-01-01	No. of contemporary road subsection	<b>TEM, TINA and E - network</b>	<b>Expressway - In operation</b>	<b>E - Road</b>
 01-01-01	No. of TEM subsection			
	City	 Motorway - In operation	 dual three-lane (2x3) or more	 dual two-lane (2x2) or more
	Town	 dual two-lane (2x2)	 dual two-lane (2x2)	 single carriageway - 4 traffic lanes or more
	Lake	 Motorway - under construction	 single carriageway - 2 or 3 lanes (left or right)	 single carriageway - 2 or 3 lanes
	River	 dual three-lane (2x3) or more	 Expressway - under construction	<b>Other main roads</b>
		 dual two-lane (2x2)	 dual two-lane (2x2)	 Section limit
		 Motorway - programmed or planned	 Expressway - programmed or planned	 TEM network and corridor
		 dual two-lane (2x2)	 single carriageway - 2 or 3 lanes (left or right)	



# Croatia

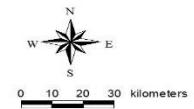
## (TEMSTAT map)



STATUS AS OF 1 JANUARY 2019



	No. of contemporary road subsection	<b>TEM, TINA and E - network</b>		
	No. of TEM subsection	<b>Motorway - in operation</b>	<b>Expressway - in operation</b>	<b>E - Road</b>
	City			
	Town			
	Lake	<b>Motorway - under construction</b>	<b>Expressway - under construction</b>	<b>Other main roads</b>
	River			
		<b>Motorway - programmed or planned</b>	<b>Expressway - programmed or planned</b>	





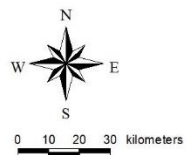
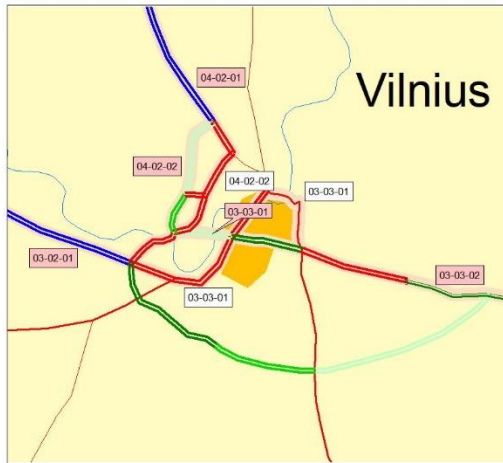
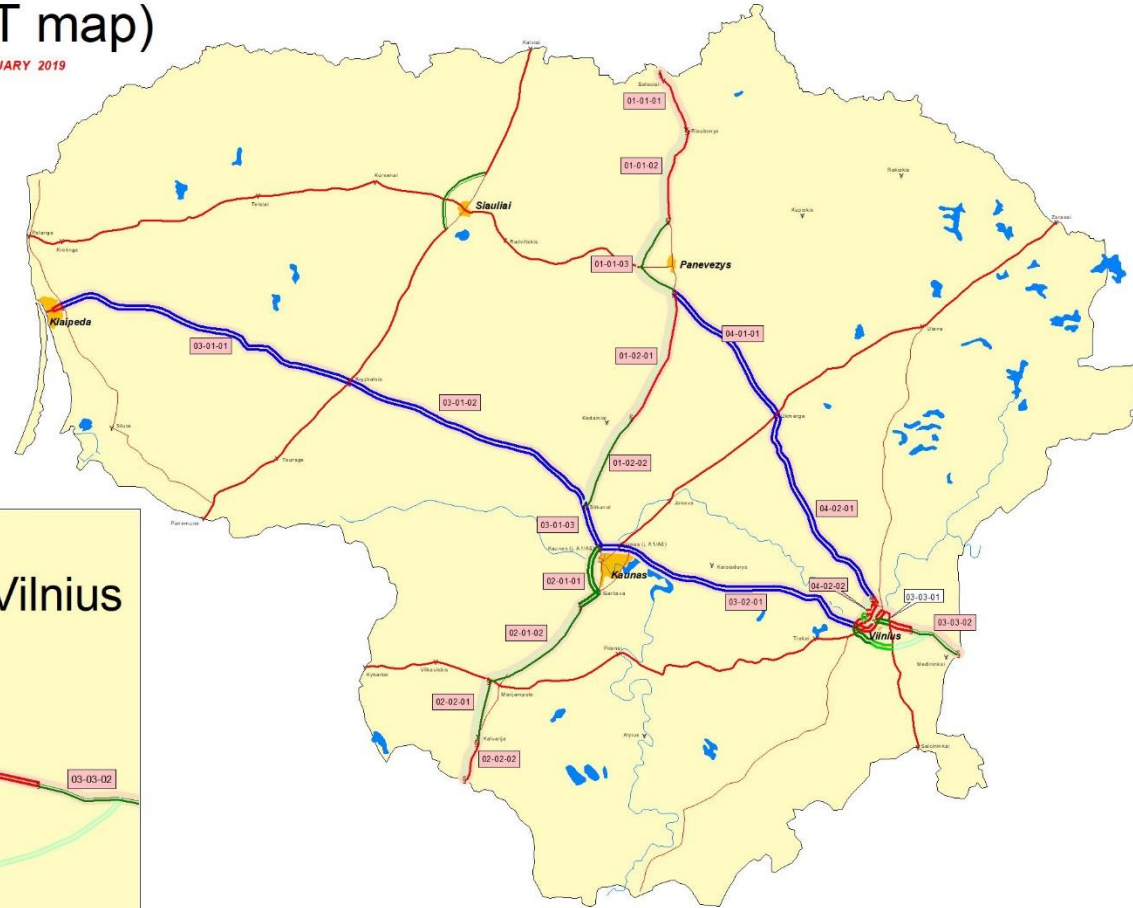


# Lithuania

## (TEMSTAT map)



STATUS AS OF 1 JANUARY 2019

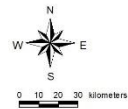
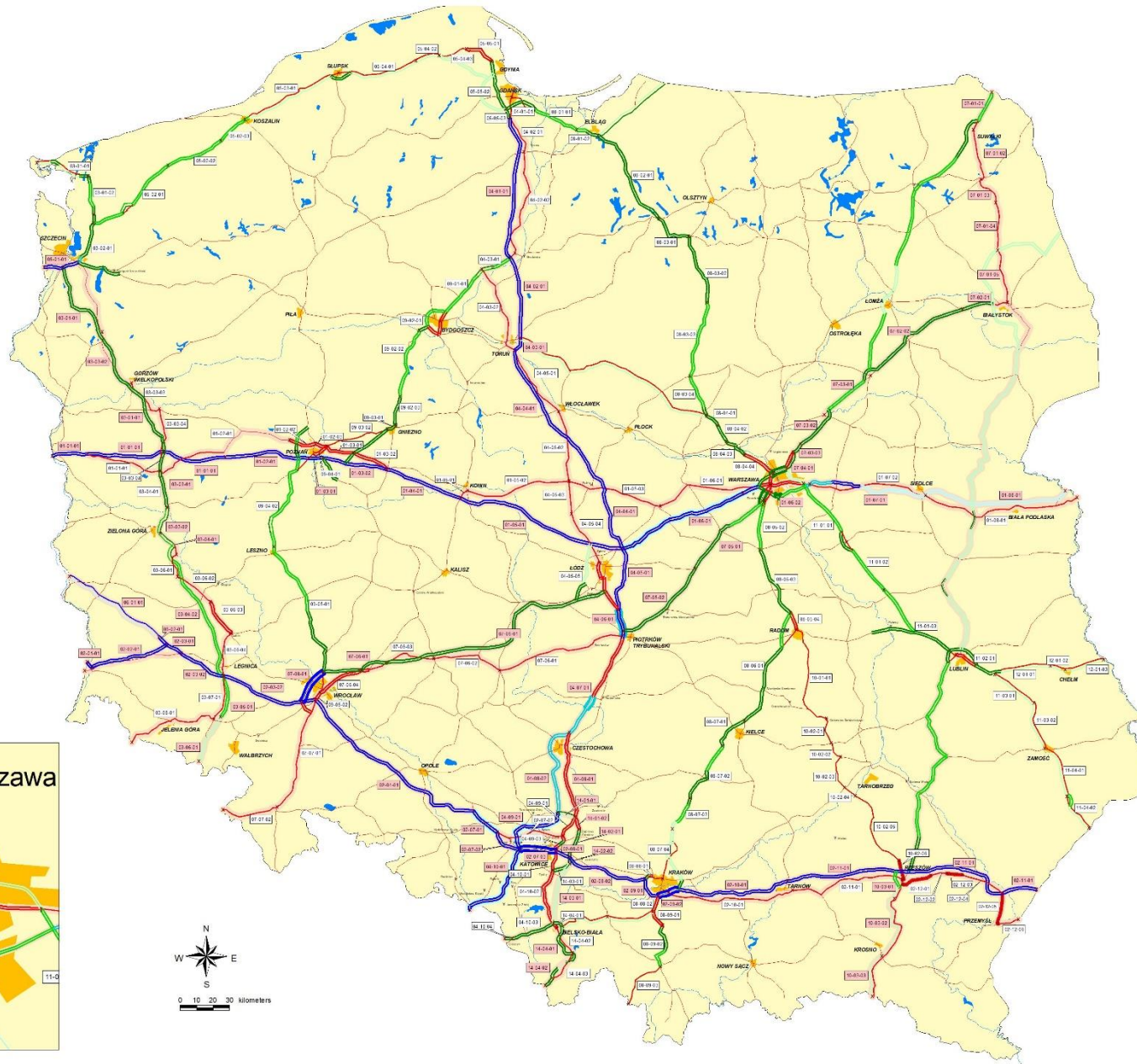


01-01-01	No. of contemporary road subsection	<b>TEM, TINA and E - network</b>	Expressway - in operation	E - Road
01-01-01	No. of TEM subsection	Motorway - in operation	dual two-lane (2x2)	dual two-lane (2x2) or more
	City	Motorway - programmed or planned	single carriageway - 2 or 3 lanes (left or right)	single carriageway - 2 or 3 lanes
	Town	Motorway - programmed or planned	Expressway - under construction	<b>Other main roads</b>
	Lake	dual three-lane (2x3) or more	dual two-lane (2x2)	Section limit
	River	single carriageway - 2 or 3 lanes (left or right)	single carriageway - 2 or 3 lanes (left or right)	TEM network and corridor
			Expressway - programmed or planned	
			dual two-lane (2x2)	
			single carriageway - 2 or 3 lanes (left or right)	

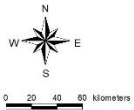
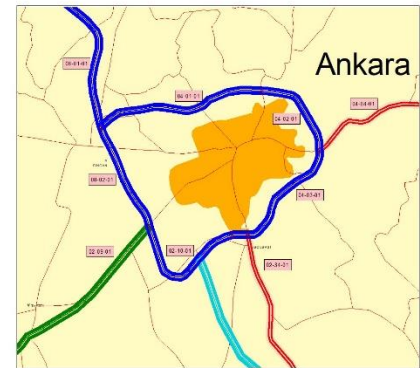


 **Poland**   
 (TEMSTAT map)  
 STATUS AS OF 1 JANUARY 2019

	No. of contemporary road subsection
	No. of TEM subsection
	City
	Town
	Lake
	River
<b>TEM, TINA and E - network</b>	
<b>Motorway - in operation</b>	
	double carriageway (2x2)
	single carriageway - 2 or 3 lanes (left or right)
<b>Motorway - under construction</b>	
	double carriageway (2x2)
	single carriageway - 2 or 3 lanes (left or right)
<b>Motorway - programmed or planned</b>	
	double carriageway (2x2)
	single carriageway - 2 or 3 lanes (left or right)
<b>Expressway - in operation</b>	
	double carriageway (2x2) or more
	double carriageway (2x2)
	single carriageway - 2 or 3 lanes (left or right)
<b>Expressway - under construction</b>	
	double carriageway (2x2) or more
	double carriageway (2x2)
	single carriageway - 2 or 3 lanes (left or right)
<b>Expressway - programmed or planned</b>	
	double carriageway (2x2)
	single carriageway - 2 or 3 lanes (left or right)
<b>E - Road and TINA road</b>	
	double carriageway (2x2) or more
	single carriageway - 4 traffic lanes or more
	single carriageway - 2 or 3 lanes
<b>Other main road</b>	
	Section limit
	TEM network and corridor







	No. of contemporary road subsection		TEM and E - network		Expressway - in operation		Other TEM and E - road
	No. of TEM subsection		Motoway - in operation		Expressway - programmed or planned		Other main roads
	City		Motoway - under construction		Motoway - programmed or planned		Section limit
	Town		Motoway - programmed or planned		TEM network and corridor		
	Lake						
	River						



# TEMSTAT map

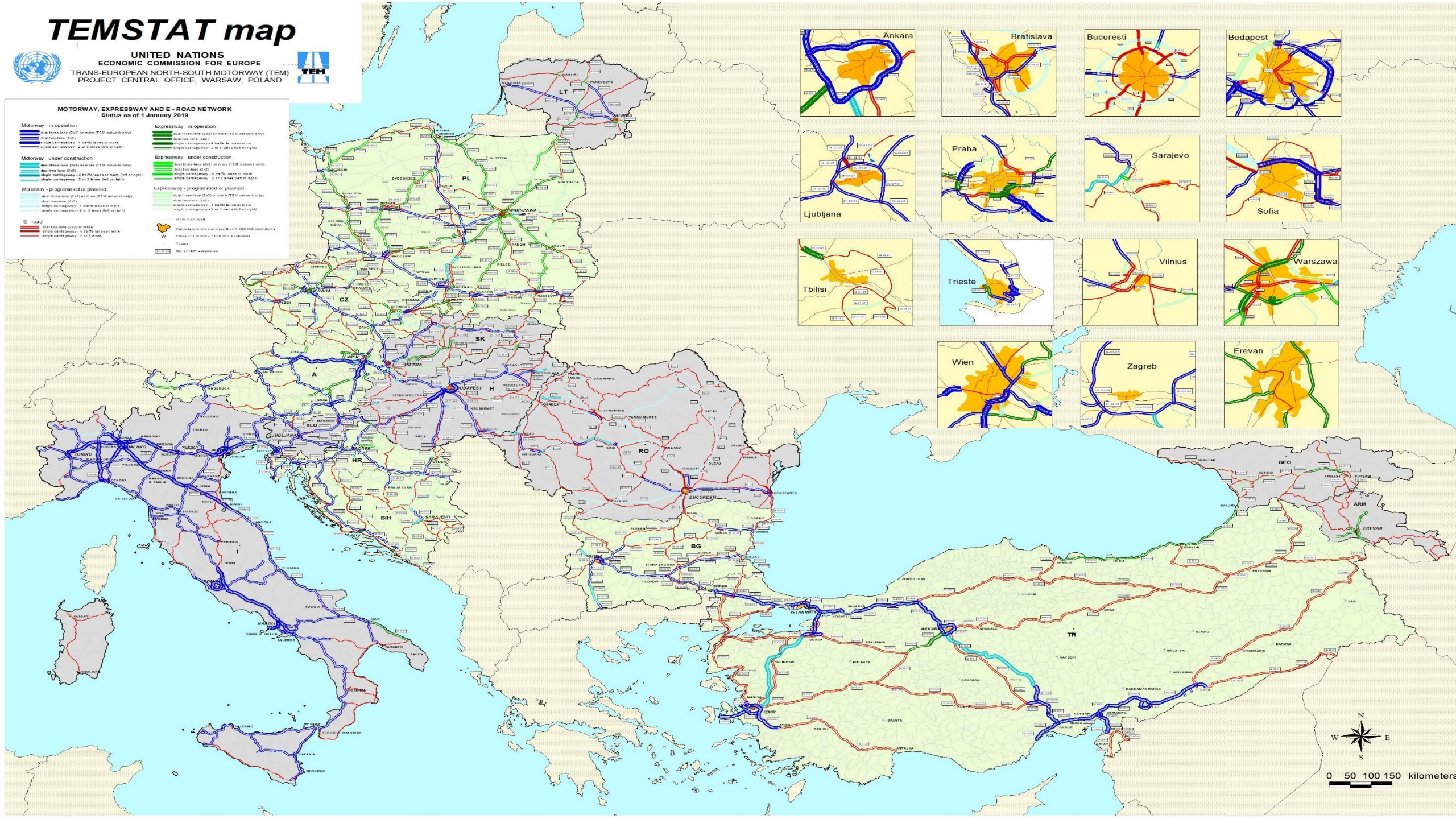
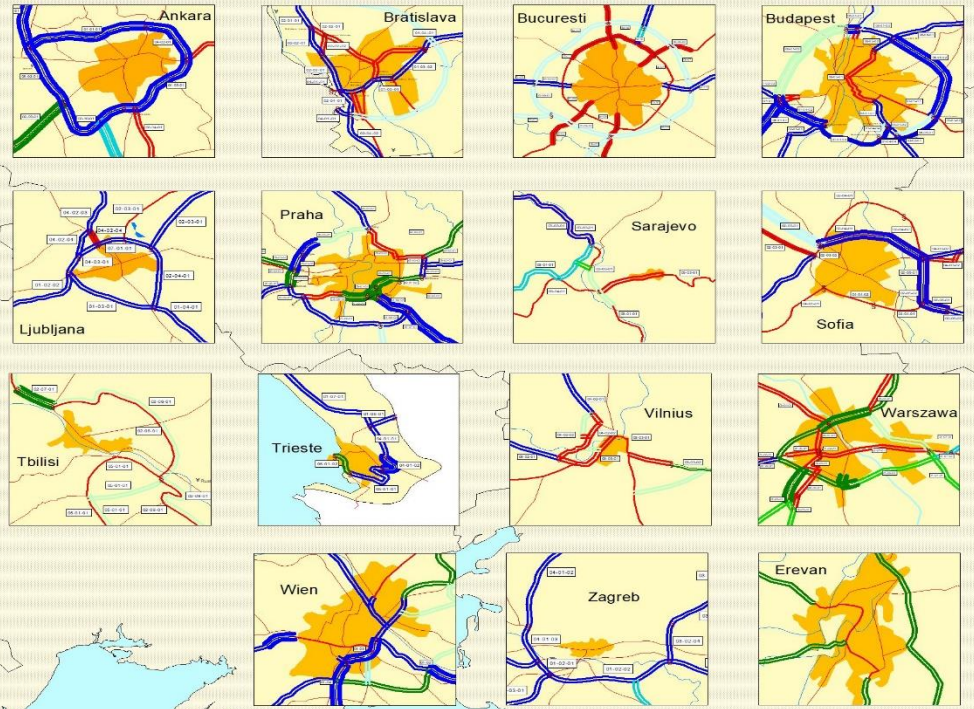


UNITED NATIONS  
ECONOMIC COMMISSION FOR EUROPE  
TRANS-EUROPEAN NORTH-SOUTH MOTORWAY (TEM)  
PROJECT CENTRAL OFFICE, WARSAW, POLAND



## MOTORWAY, EXPRESSWAY AND E-ROAD NETWORK Status as of 1 January 2019

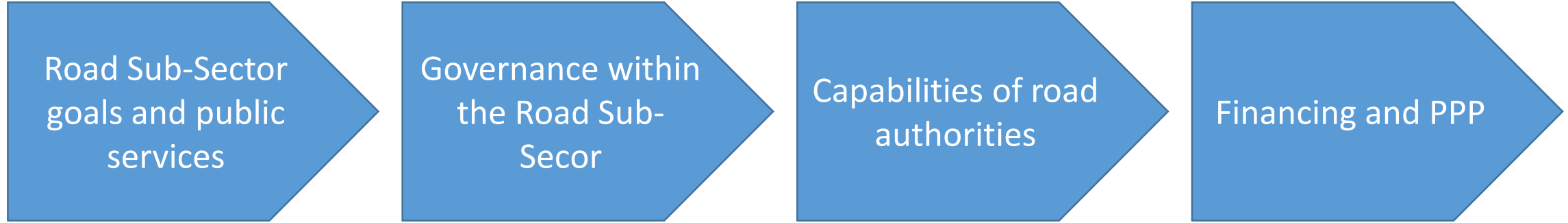
- |   |   |
|---|---|
| <p><b>Motorway - in operation</b></p> <ul style="list-style-type: none"> <li> dual three-lane (2x1) or more (TEM network only)</li> <li> dual two-lane (2x2)</li> <li> single carriageway - 4 traffic lanes or more (left or right)</li> <li> single carriageway - 2 or 3 lanes (left or right)</li> </ul> <p><b>Motorway - under construction</b></p> <ul style="list-style-type: none"> <li> dual three-lane (2x1) or more (TEM network only)</li> <li> dual two-lane (2x2)</li> <li> single carriageway - 4 traffic lanes or more (left or right)</li> <li> single carriageway - 2 or 3 lanes (left or right)</li> </ul> <p><b>Motorway - programmed or planned</b></p> <ul style="list-style-type: none"> <li> dual three-lane (2x1) or more (TEM network only)</li> <li> dual two-lane (2x2)</li> <li> single carriageway - 4 traffic lanes or more</li> <li> single carriageway - 2 or 3 lanes (left or right)</li> </ul> | <p><b>Expressway - in operation</b></p> <ul style="list-style-type: none"> <li> dual three-lane (2x1) or more (TEM network only)</li> <li> dual two-lane (2x2)</li> <li> single carriageway - 4 traffic lanes or more</li> <li> single carriageway - 2 or 3 lanes (left or right)</li> </ul> <p><b>Expressway - under construction</b></p> <ul style="list-style-type: none"> <li> dual three-lane (2x1) or more (TEM network only)</li> <li> dual two-lane (2x2)</li> <li> single carriageway - 4 traffic lanes or more</li> <li> single carriageway - 2 or 3 lanes (left or right)</li> </ul> <p><b>Expressway - programmed or planned</b></p> <ul style="list-style-type: none"> <li> dual three-lane (2x1) or more (TEM network only)</li> <li> dual two-lane (2x2)</li> <li> single carriageway - 4 traffic lanes or more</li> <li> single carriageway - 2 or 3 lanes (left or right)</li> </ul> |
| <p><b>E-road</b></p> <ul style="list-style-type: none"> <li> dual three-lane (2x1) or more</li> <li> single carriageway - 4 traffic lanes or more</li> <li> single carriageway - 2 or 3 lanes</li> </ul>  | <p> Coastal and cities of more than 1 000 000 inhabitants</p> <p> Cities of 100 000 - 1 000 000 inhabitants</p> <p> Towns</p> <p> Villages</p> <p> No. of TEM selection</p>   |



0 50 100 150 Kilometers



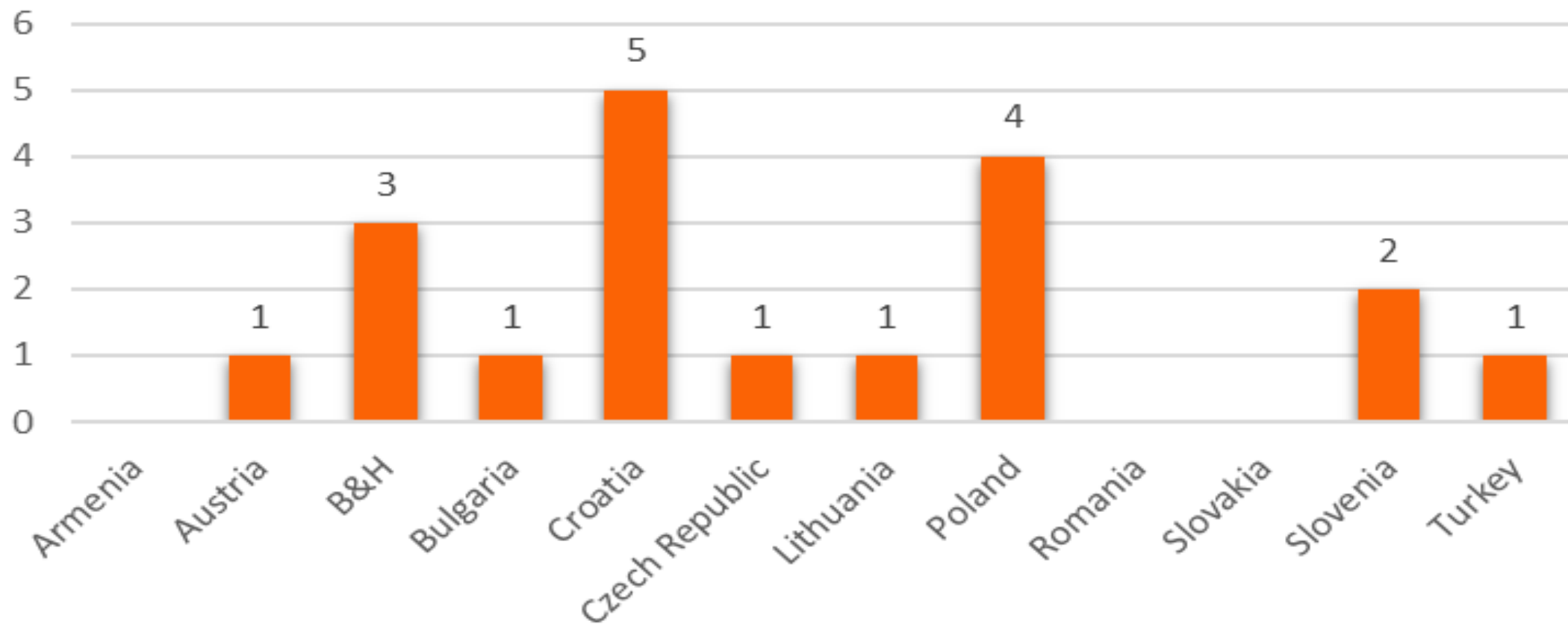
# Business models for road sub-Sector in TEM Region



# Business models for road sub-Sector in TEM Region

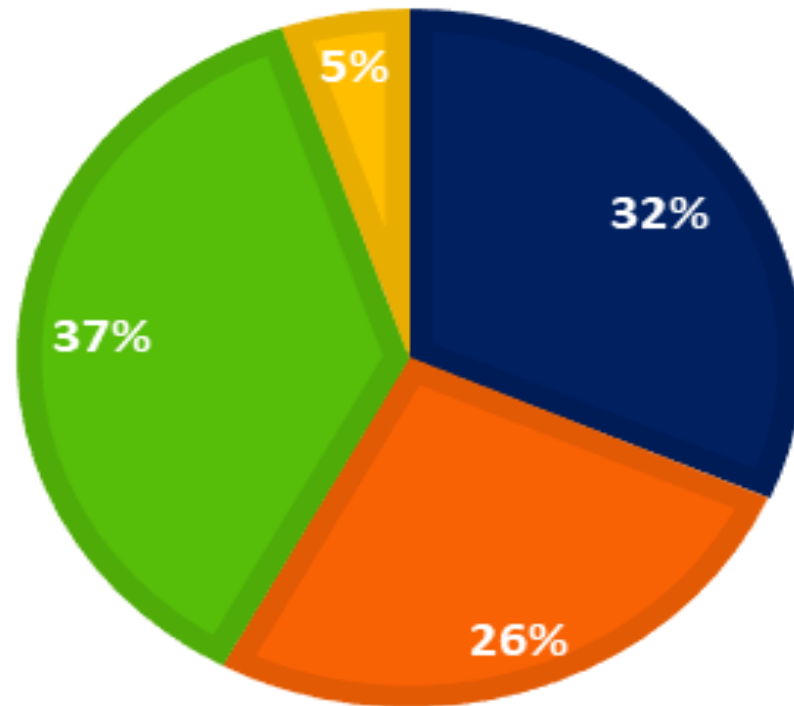
## Governance within the road sub-sector

## Number of road authorities (including concessionaires)



## LEGAL FORMS OF ROAD AUTHORITIES (INCLUDING CONCESSIONAIRES)

■ Public authority ■ Private operator ■ SOE ■ JSC

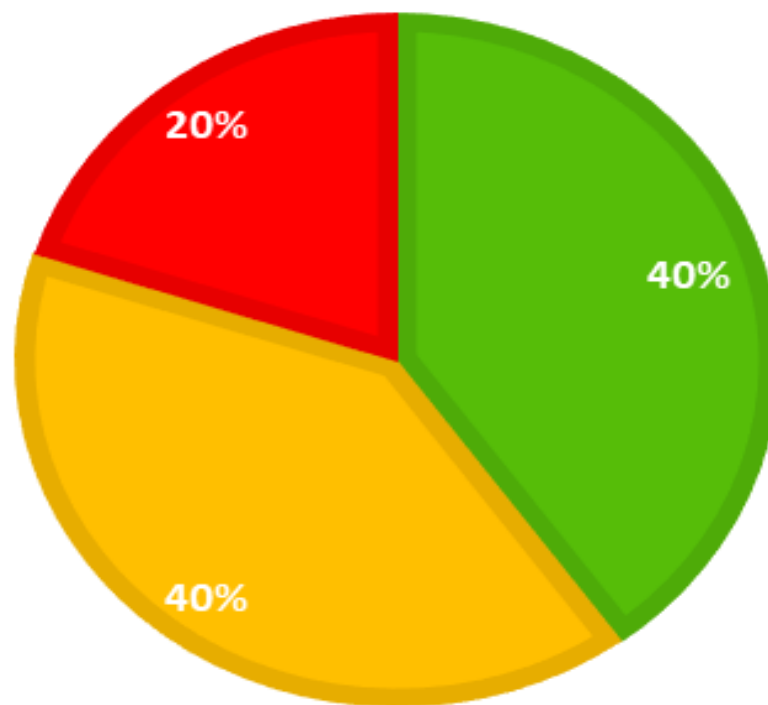


# Business models for road sub-Sector in TEM Region

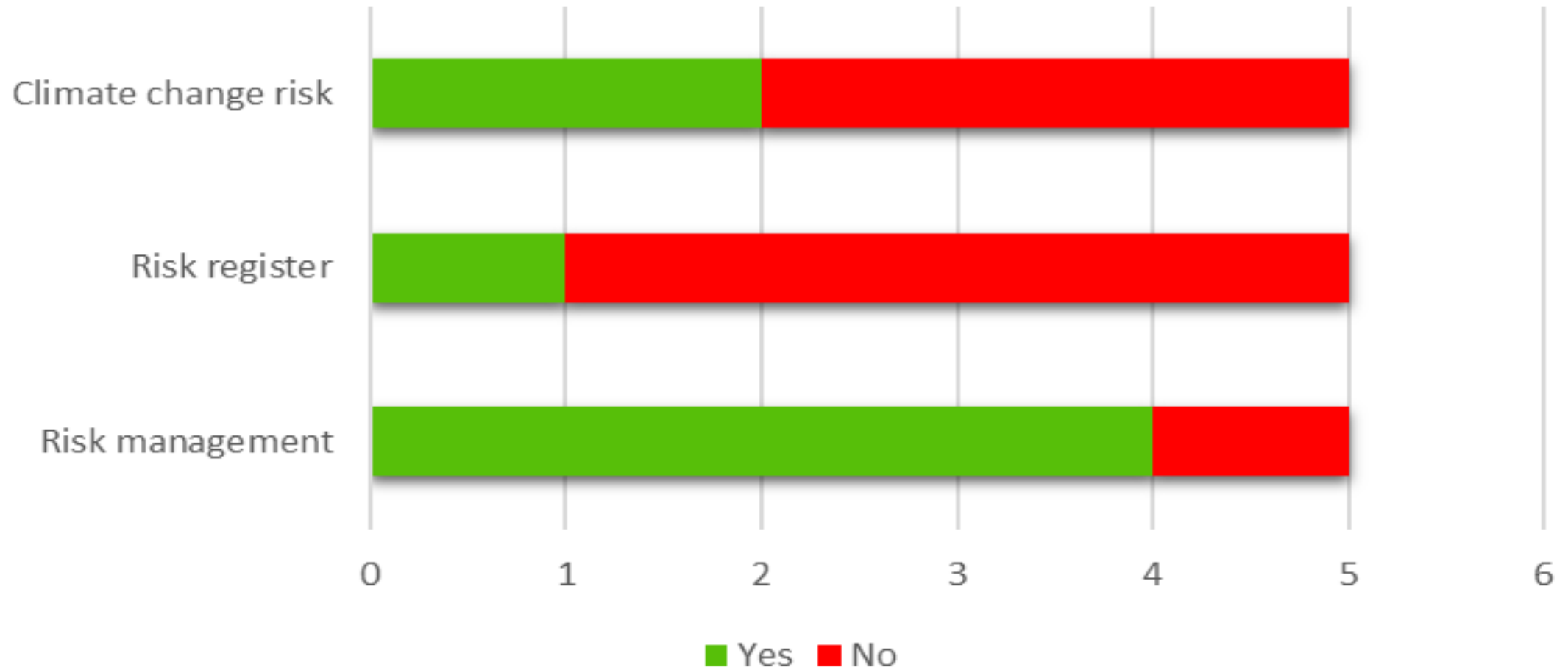
## Capabilities of the road authorities

## PERFORMANCE ASSESSMENT (OPERATING COST, UTILIZATION, PHYSICAL AND FUNCTIONAL FAILURE LIKELIHOOD)

■ Full ■ Partial ■ Any



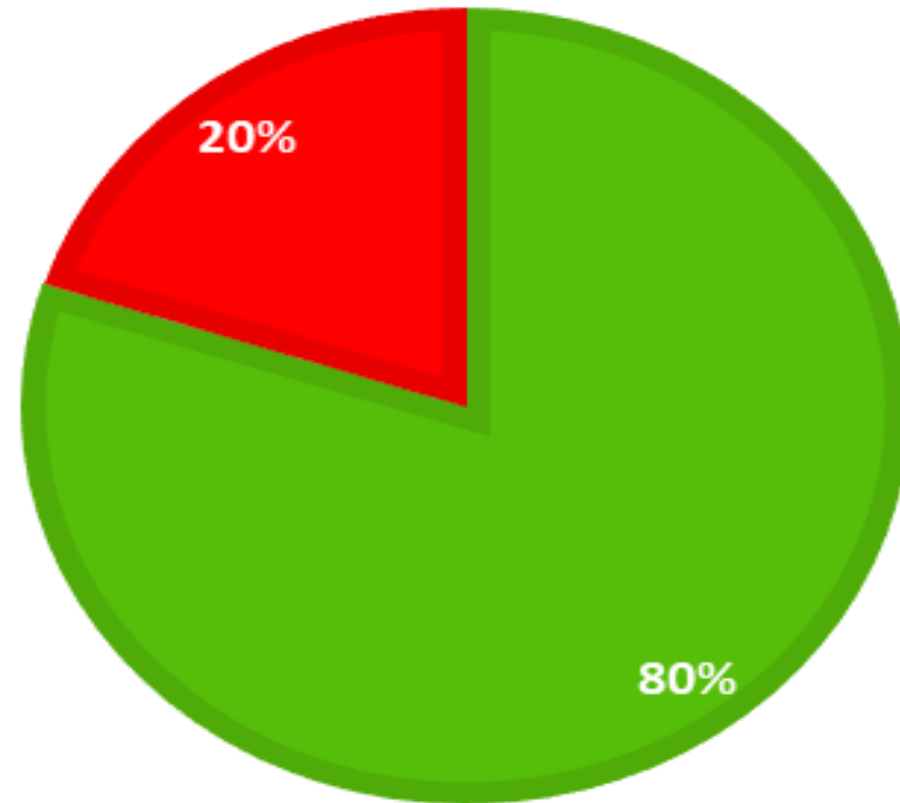
# Risk management





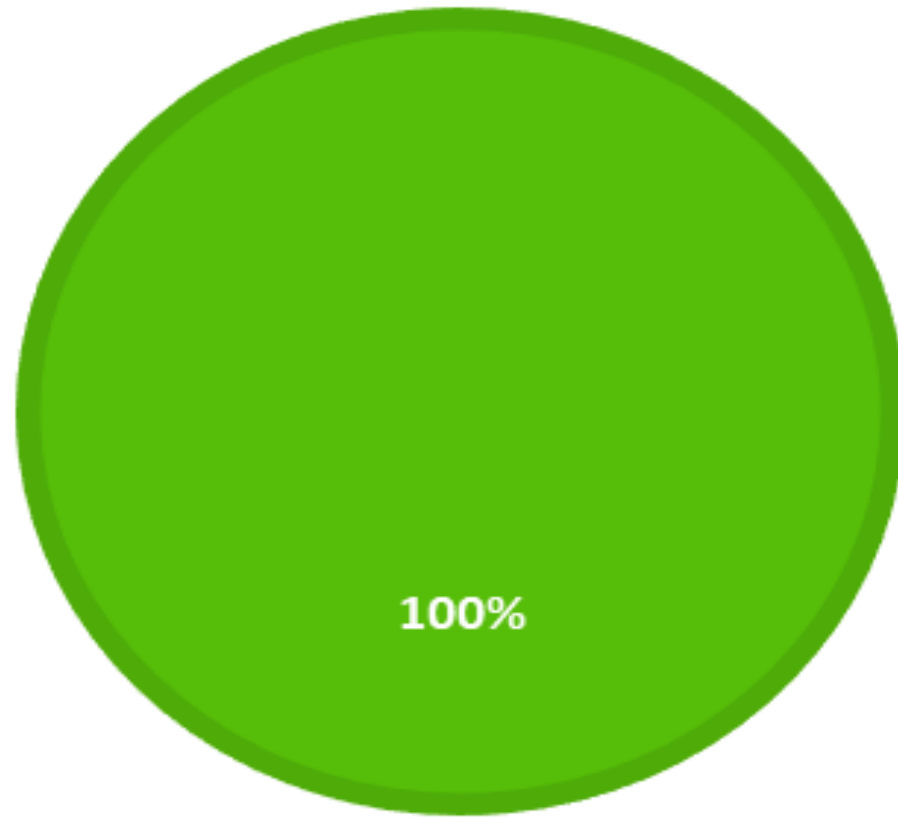
# LIFE CYCLE ANALYSIS AND PLANNING

■ Yes ■ No



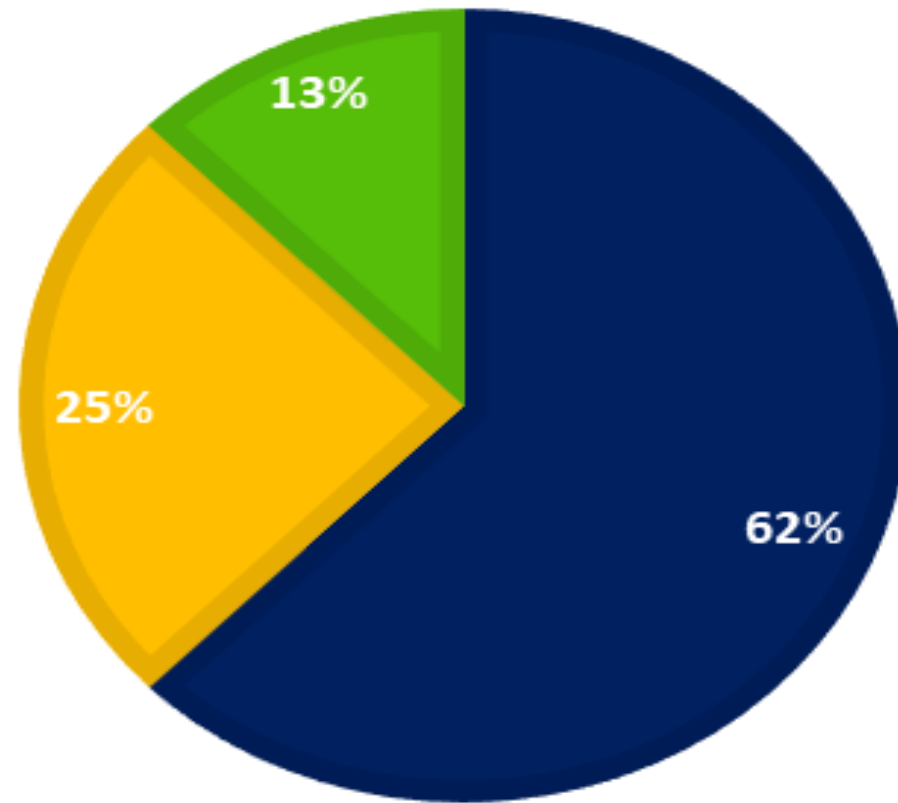
# MULTIANNUAL PLANNING

■ Yes ■ No



# PLANNING HORIZON

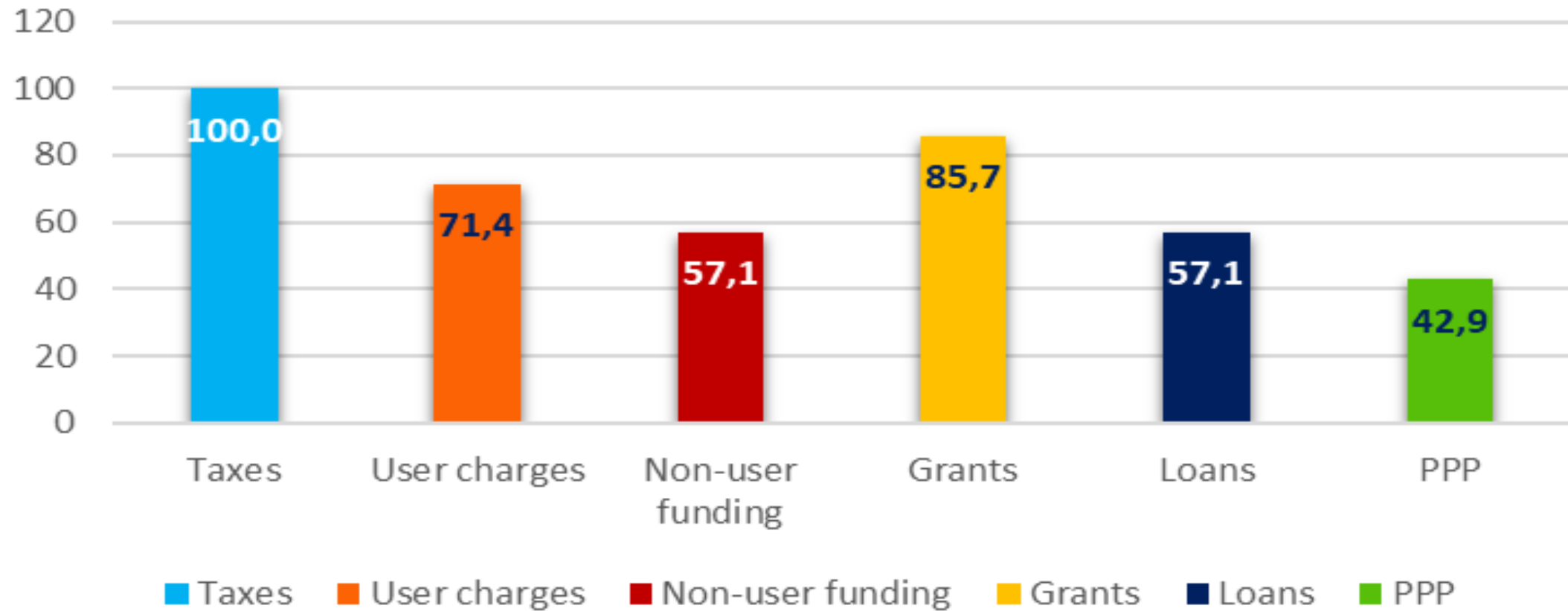
■ Up to 5 years   ■ Up to 10 years   ■ More than 10 years



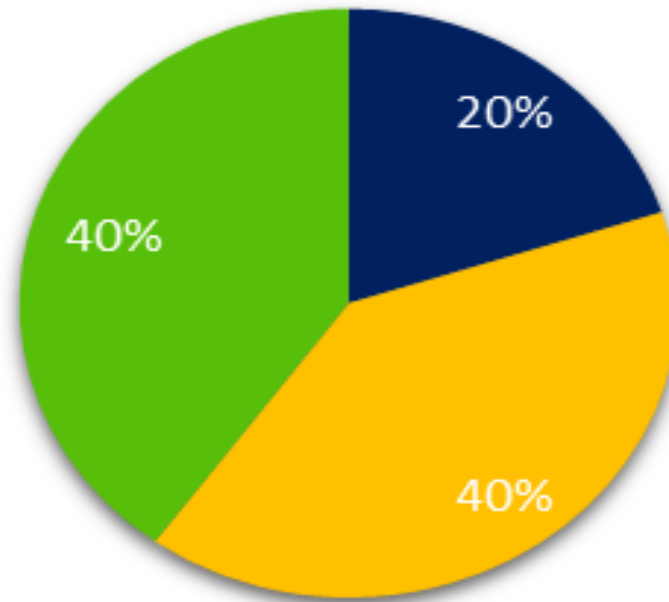
# Business models for road sub-Sector in TEM Region

## Financing and PPP

## Percentage of funding sources' usage in TEM Member Countries



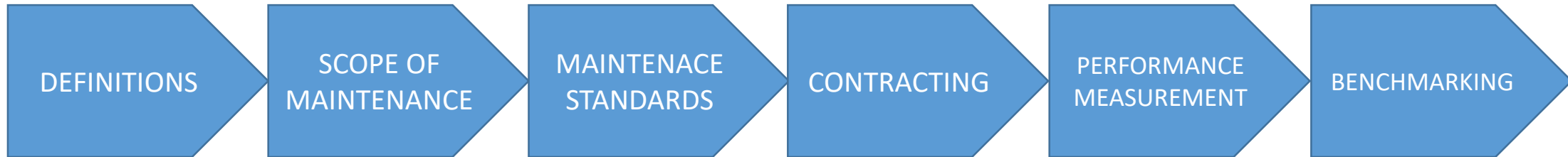
## Percentage of TEM Member Countries using different funding sources



- Non-earmarked state budget funds
- Earmarked state budget funds
- Dedicated road fund

# Maintenance Service Levels for TEM Network

- Flow of the report



# Maintenance Service Levels for TEM Network Definitions

- The definitions are divided in five sub-chapters, considering different types of specialized works and services related to regular road maintenance:
  - Maintenance management
  - Inspection, assessment and testing
  - Faults and damages
  - Maintenance works, repairs and rehabilitation
  - Maintenance strategy and contracting



# Maintenance Service Levels for TEM Network

## Scope of maintenance

- The scope of maintenance proposed by the consultant is as follows:
  - Pavement
    - Defects on the pavement
    - Maintenance of the pavement
  - Roadside areas and drainage
    - Roadside areas
    - Drainage system (defects + maintenance)
  - Bridges and structures
  - Traffic control devices
  - Winter maintenance
  - Temporary traffic management in work zones

# Maintenance Service Levels for TEM Network

## Maintenance standards

- The consultant proposed 6 categories according to the norm COST 354
  - Coefficiency of friction
  - Mean profile depth
  - Roughness
  - Rutting
  - Grid cracks
  - Transverse cracks

# Maintenance Service Levels for TEM Network

## Maintenance standards

- Coefficient of friction

Classification	SFC (60km/h)	LFC (50km/h)
very good	0,64 – 0,58	0,67 – 0,60
good	0,58 – 0,52	0,60 – 0,53
acceptable	0,52 – 0,47	0,53 – 0,46
bad	0,47 – 0,41	0,46 – 0,38
very bad	0,41 – 0,35	0,38 – 0,31

# Maintenance Service Levels for TEM Network

## Maintenance standards

- Mean profile depth

Classification	MPD (mm) – Highways	MPD (mm) County Roads
very good	1,25 – 1,06	1,01 – 0,87
good	1,06 – 0,87	0,87 – 0,72
acceptable	0,87 – 0,68	0,72 – 0,58
bad	0,68 – 0,49	0,58 – 0,43
very bad	0,49 - 0,30	0,43 – 0,29

# Maintenance Service Levels for TEM Network

## Maintenance standards

- Roughness

Classification	IRI <sub>100</sub> – Highways and Main Roads (m/km)	IRI <sub>100</sub> – Other Roads (m/km)
very good	< 1,1	< 1,2
good	1,1 do 1,9	1,2 do 2,5
acceptable	1,9 do 2,6	2,5 do 3,7
bad	2,6 do 3,2	3,7 do 4,9
very bad	> 3,2	> 4,9

# Maintenance Service Levels for TEM Network

## Maintenance standards

- Rutting

Classification	Rut Depth (mm) – Highways and State Roads	Rut Depth (mm) - Country Roads and Local Roads
very good	< 4,5	< 4,9
good	4,5 do 9,3	4,9 do 10,5
acceptable	9,3 do 14,5	10,5 do 17,2
bad	14,5 do 20,1	17,2 do 25,8
very bad	20,1 do 26,4	25,8 do 46,6

# Maintenance Service Levels for TEM Network

## Maintenance standards

- Grid cracks

Classification	Cracking of the pavement surface (%)
very good	without cracks
good	< 5 %
acceptable	5 – 20 %
bad	20 – 40 %
very bad	> 40 %

# Maintenance Service Levels for TEM Network

## Maintenance standards

- Transverse cracks

Classification	Cracking of the pavement surface (%)
very good	without cracks
good	< 2 %
acceptable	2 – 10 %
bad	10 – 20 %
very bad	> 20 %



# Maintenance Service Levels for TEM Network Contracting

- Types of contracting:
  - Performance-based
  - Measurement-based
- In-house contracting versus outsourcing of maintenance services and works
- Measurement and payment:
  - Performance (outcome) – based
  - Output-based
  - Input-based (i.e. working days)

# Maintenance Service Levels for TEM Network Performance measurement

- Methods and devices for measuring and testing the characteristics of the road surface of the pavement
  - Skid resistance/friction
  - Texture of the pavement
  - Roughness
  - Transversal roughness
  - Noise
  - Bearing capacity
  - Layer thickness

# Maintenance Service Levels for TEM Network

## Counting maintenance needs (NCHRP)

