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Road resilience: lessons learnt

Based on case studies in Paraguay, Albania, Dominican Republic and the Netherlands

Thomas Bles, Margreet van Marle, Mike Woning, Mark de Bel

Critical Infrastructures and society
Need for increasing resilience

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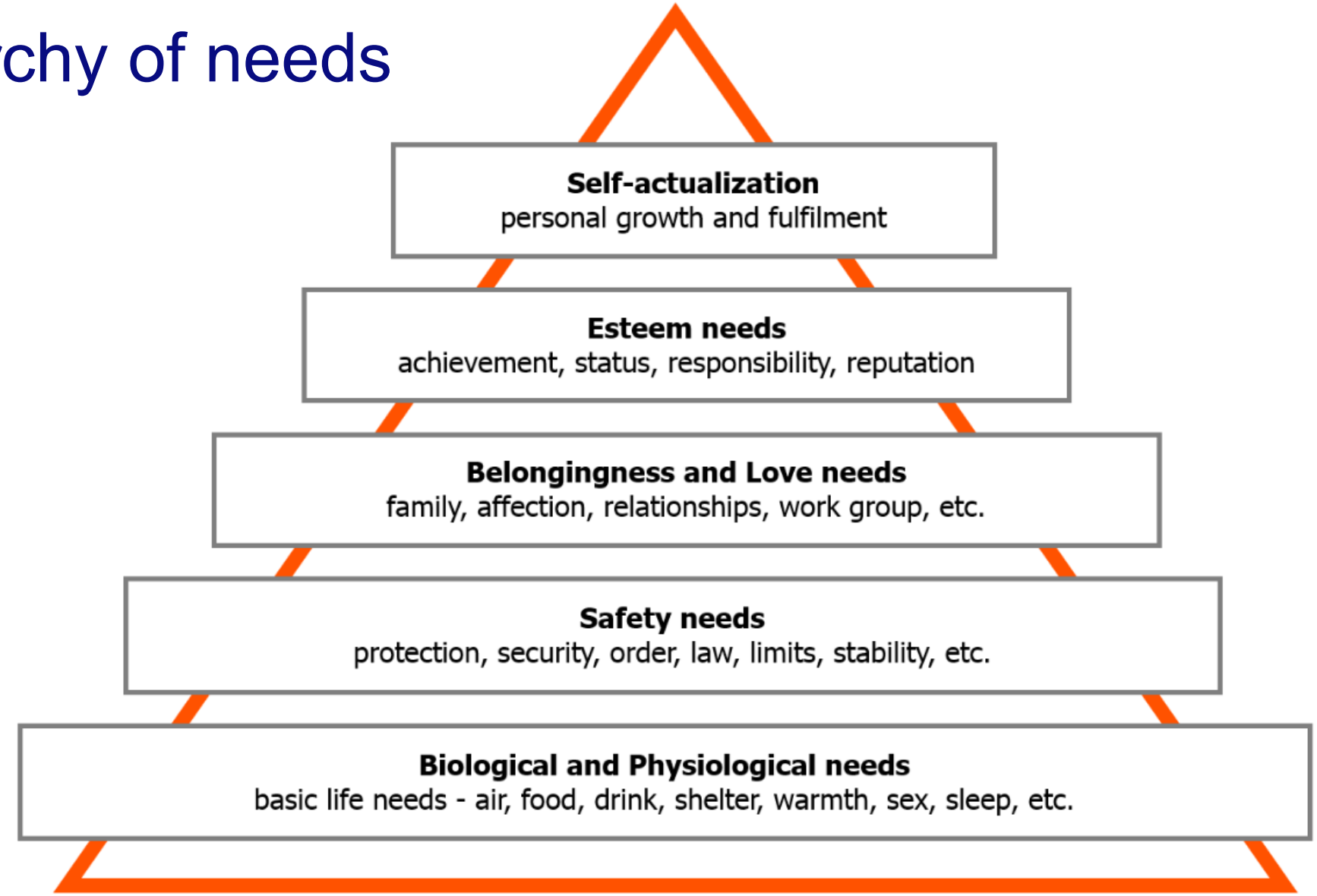
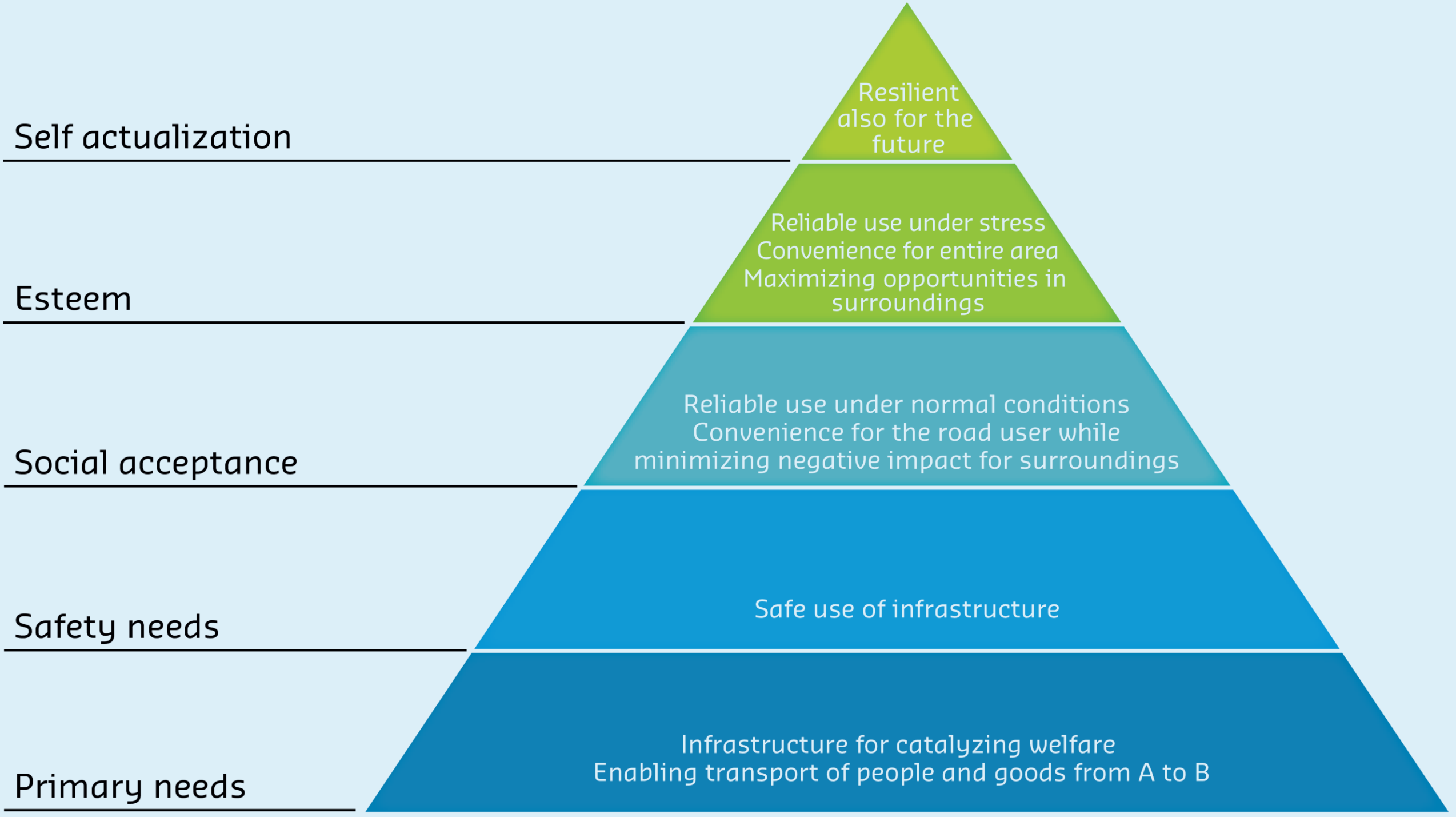
Maslow's Hierarchy of needs




Self actualization
Esteem
Social acceptance
Safety needs
Primary needs
Resilient
also for the
future
Reliable use under stress
Convenience for entire area
Maximizing opportunities in
surroundings
Reliable use under normal conditions
Convenience for the road user while
minimizing negative impact for surroundings
Safe use of infrastructure
Infrastructure for catalyzing welfare
Enabling transport of people and goods from A to B

PHILIPPINES, CABANATUAN CITY

AUSTRALIA

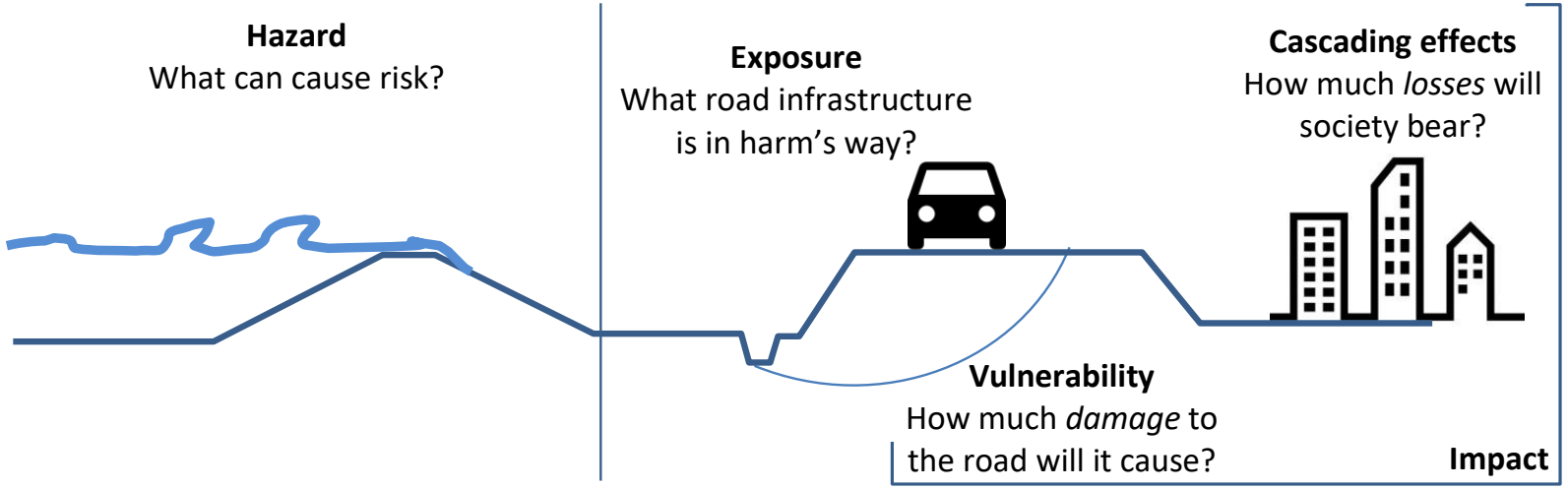
NEW ZEALAND, ARTHUR PASS

A4 MIDDEN DELFLAND, THE NETHERLANDS

PORT OF ROTTERDAM, THE NETHERLANDS

Natural Hazard Resilience Assessments
From Theory to Practice

Risk Components
(UNISDR 2016)



Hazard assessment → Exposure assessment → Vulnerability assessment → Impact assessment → Risk evaluation → Action perspective

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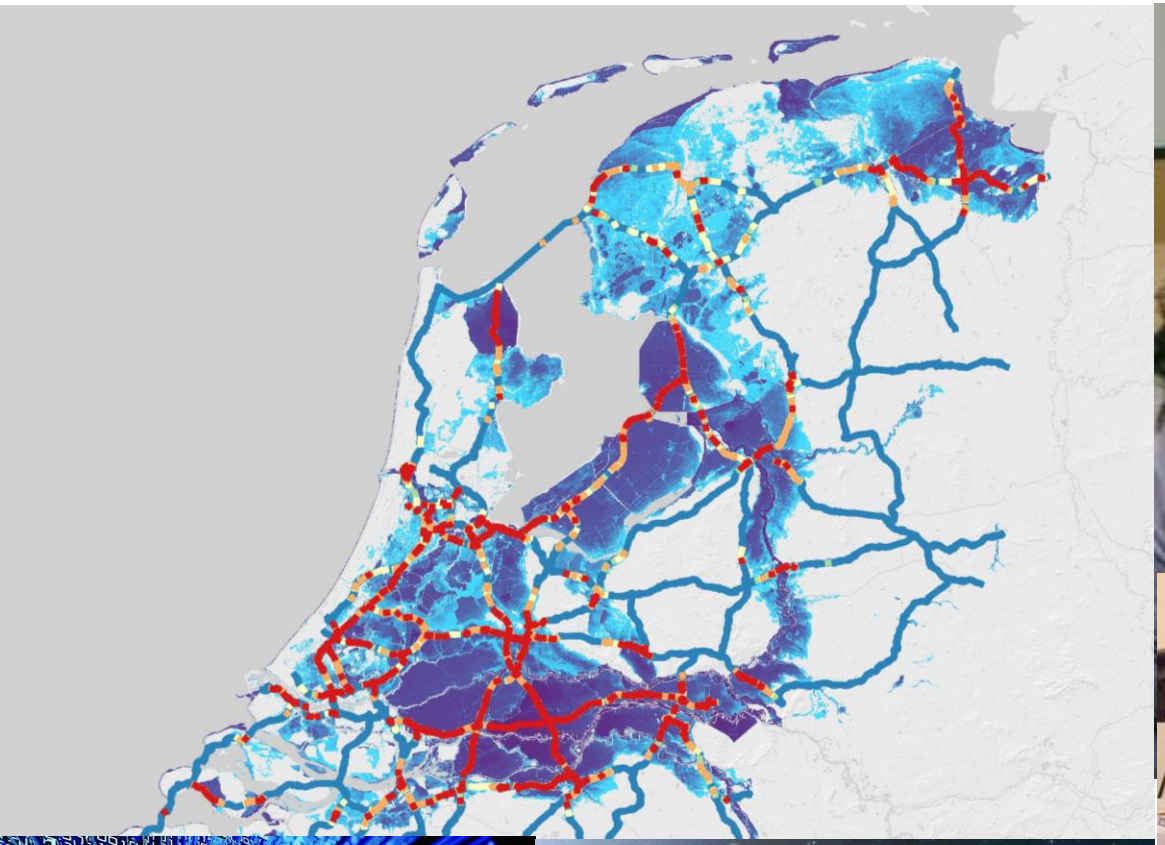
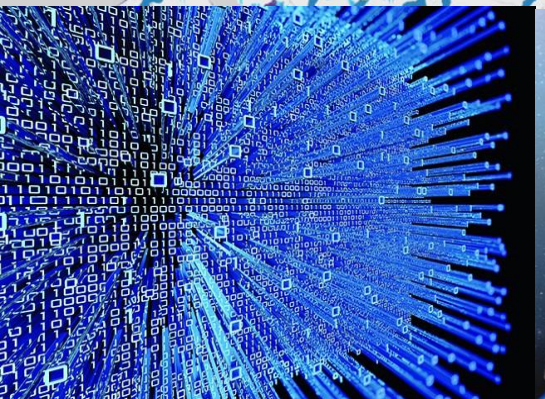
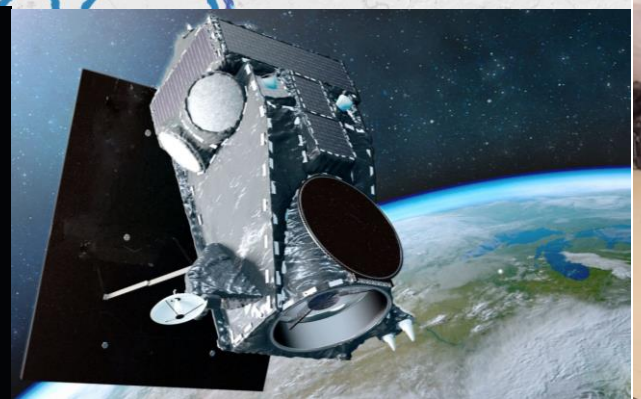
Natural Hazard Resilience Asessments
Criteria for differentation between approaches

- Risk assessment and evaluation of actions
- Quantitative and qualitative
- Deterministic and probabilistic
- Desk study and collaborative
- Single hazard or multi hazard
- Methods for evaluating meaures
- Road network, transport system or system of systems level approach
- Status quo and looking towards the future
- Decision making under (deep) uncertainty

Quantitative and qualitative, desk and collaborative

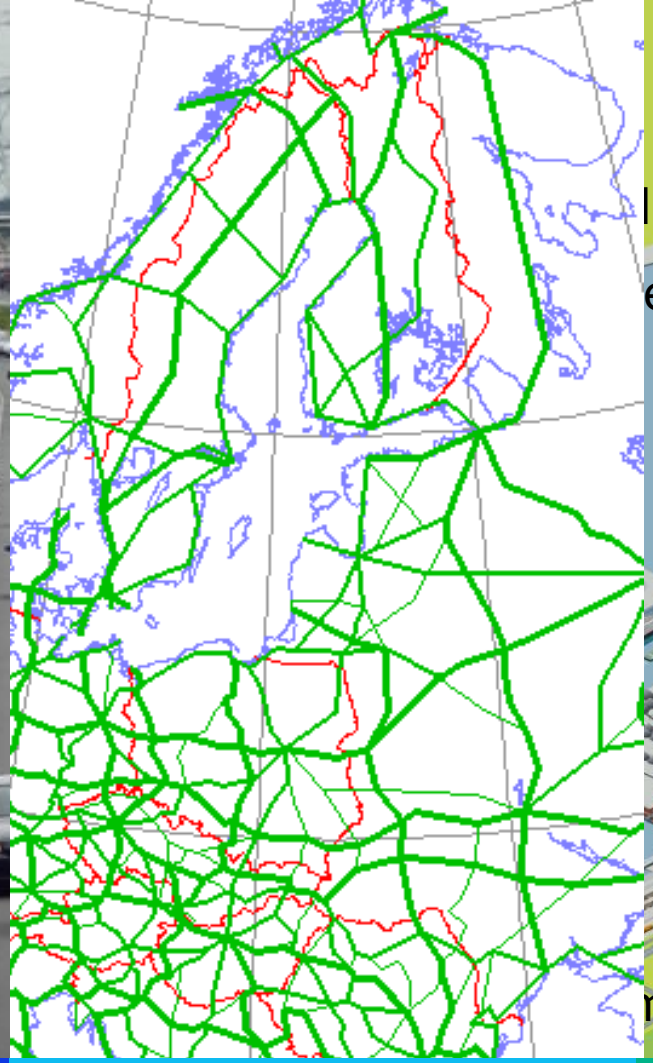






Individual assets

Connections



Network level

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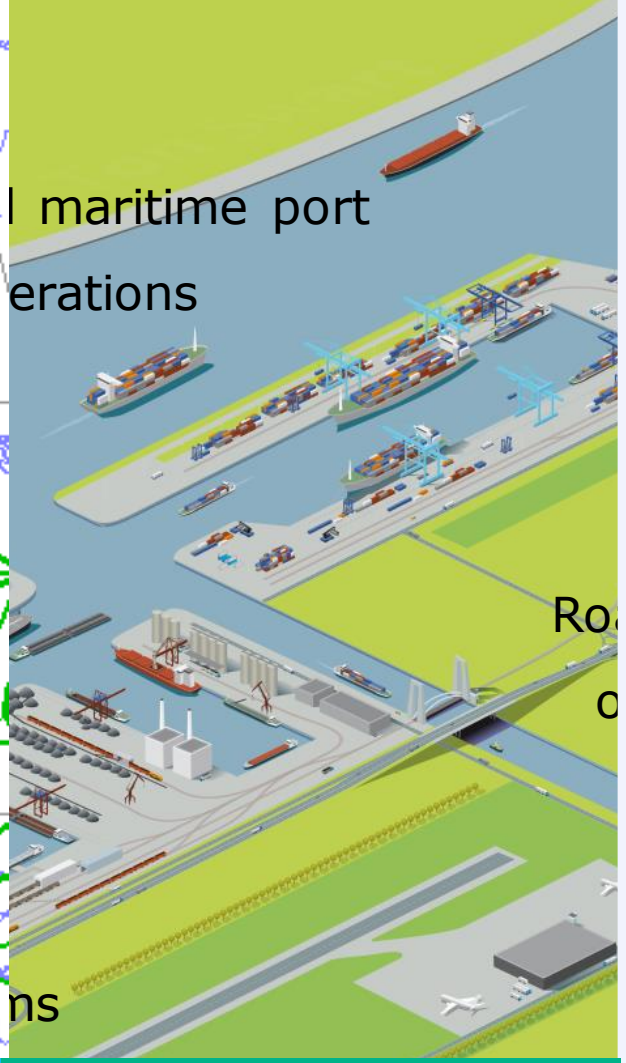
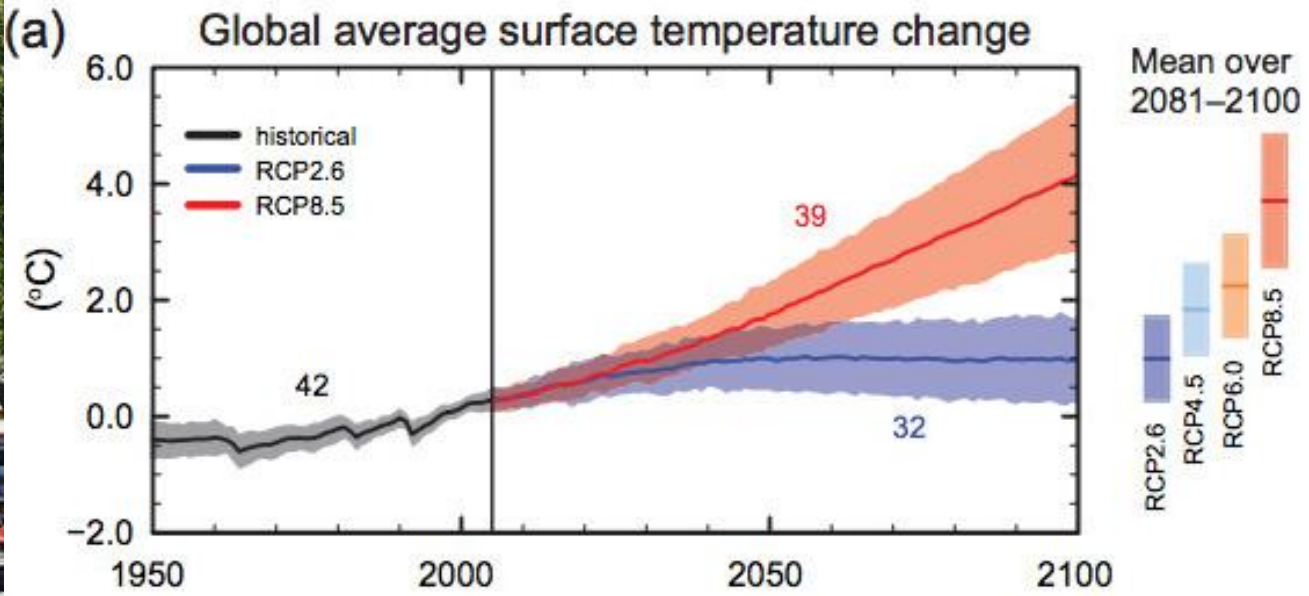


System of systems

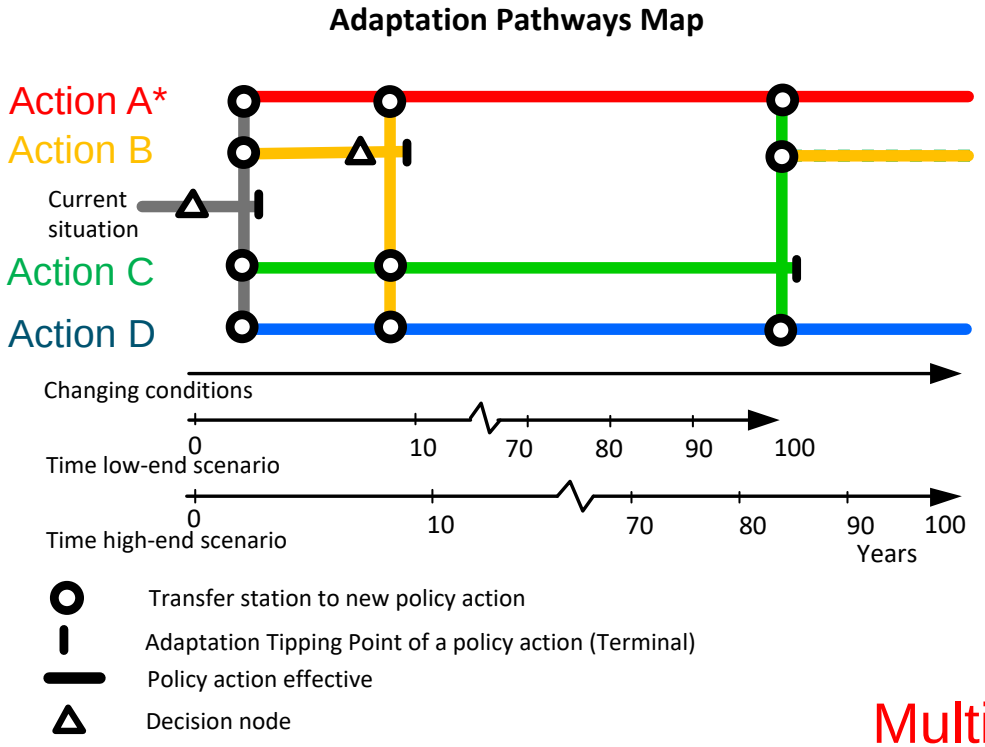
Status quo and looking towards an uncertain future



Decision making under (deep) uncertainty

Adaptation pathways illustrate **different possible sequences of investment decisions**.

MCA scorecard can be used to evaluate the pathways and potential decisions.



Costs and benefits of pathways

Time horizon 20 years
Time horizon 50 years
Time horizon 100 years

Pathway	Costs	Benefits	Co-benefits
1	+++	+	0
2	+++++	0	0
3	+++	0	0
4	+++	0	0
5	0	0	-
6	++++	0	-
7	+++	0	-
8	+	+	- - -
9	++	+	- - -

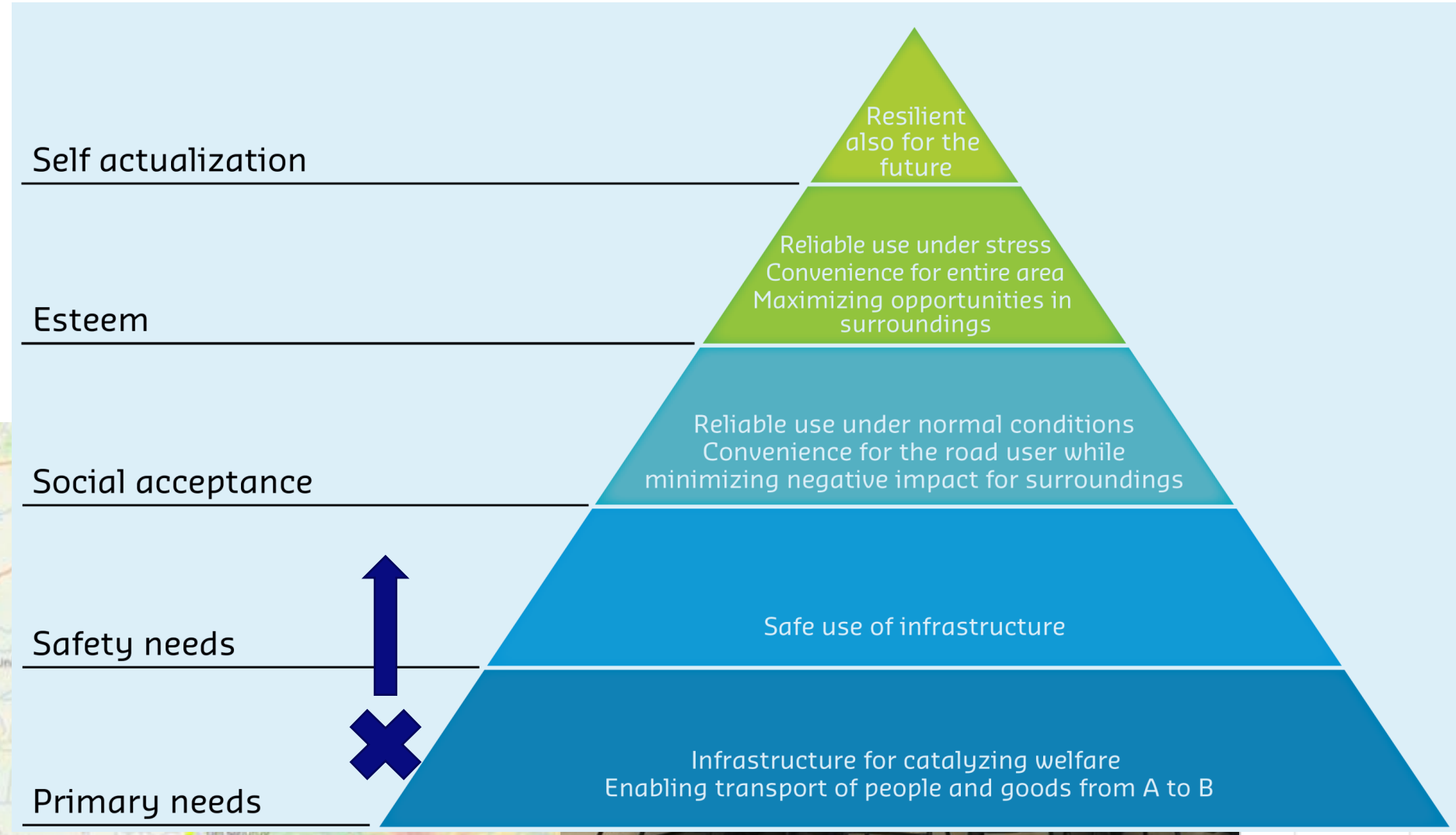
Pathways that are not necessary in low-end scenario

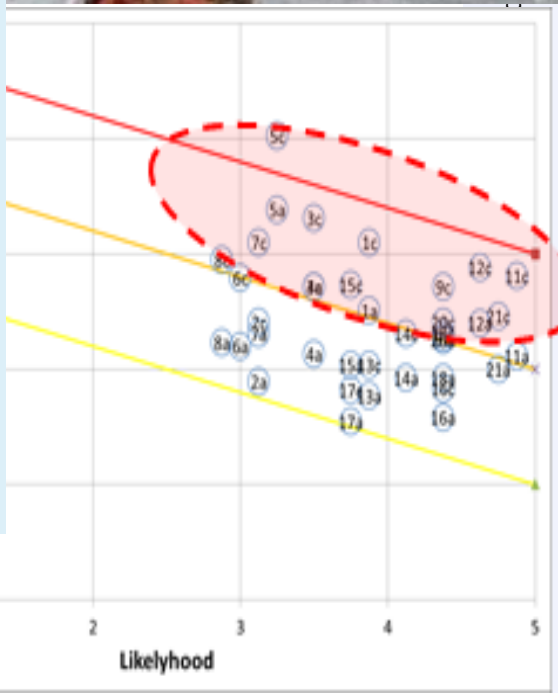
Multiple time-axes display uncertainty in moment of ATP

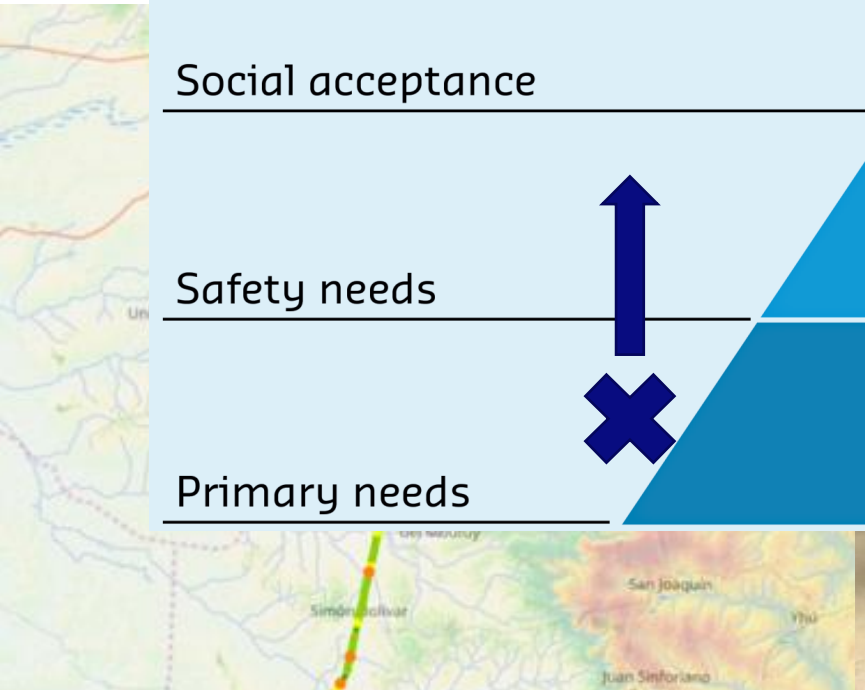
* single action or portfolio of actions

Haasnoot et al. (2012). Clim. Change.; Haasnoot et al. (2013) Glob. Env. Change. 10.1016/j.gloenvcha.2012.12.006

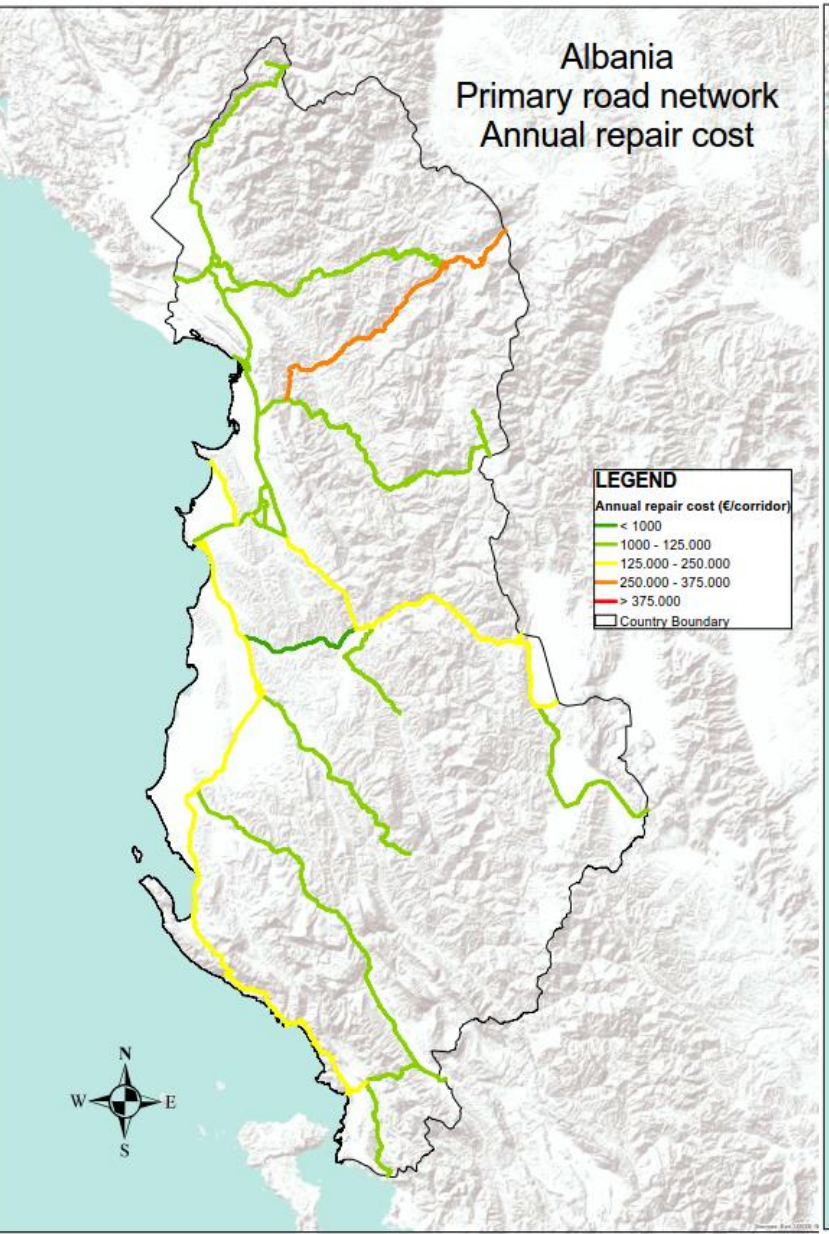
CREMA corridor, Paraguay

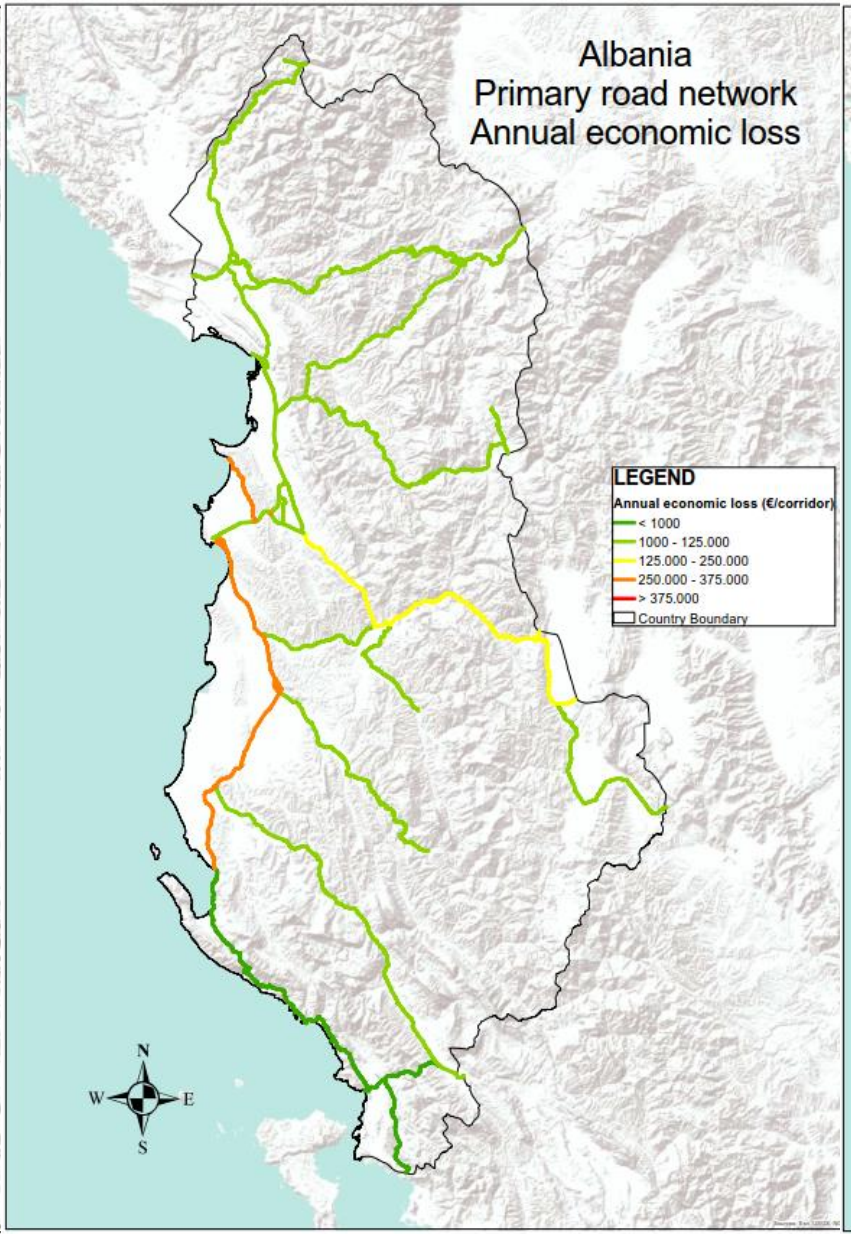


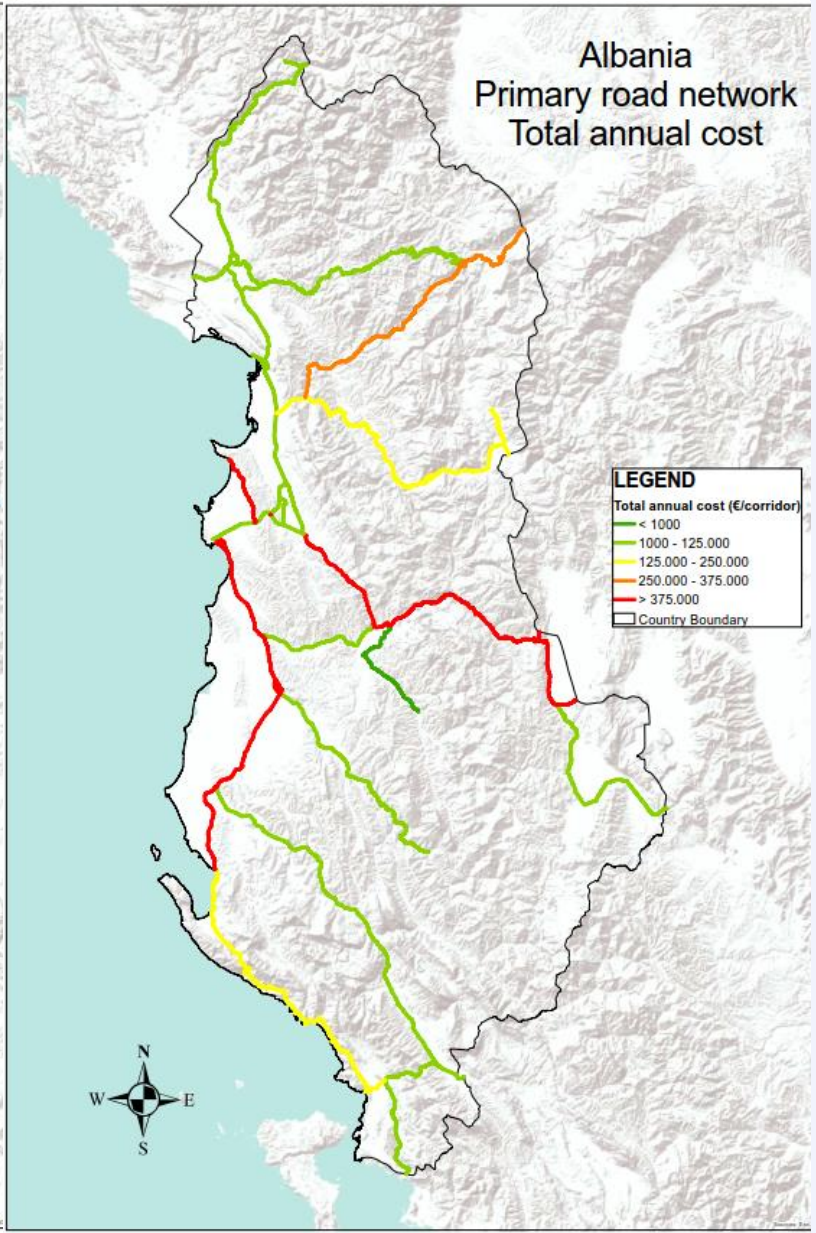




Albania

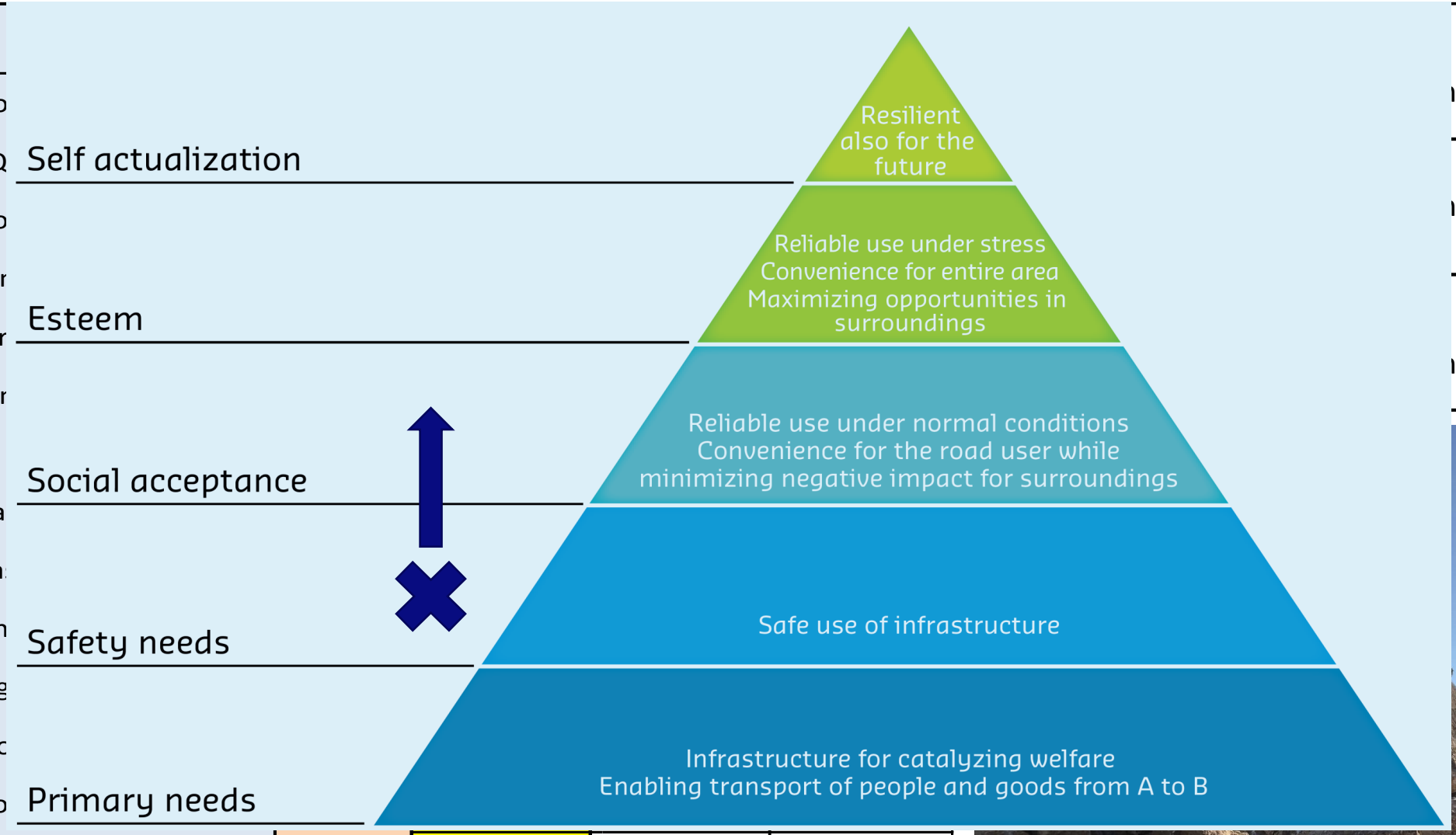

Albania
Primary road network
Annual repair cost
LEGEND
Annual repair cost (€/corridor)
< 1000
1000 - 125.000
125.000 - 250.000
250.000 - 375.000
> 375.000
Country Boundary
N
W
E
S


Albania
Primary road network
Annual economic loss
LEGEND
Annual economic loss (€/corridor)
< 1000
1000 - 125.000
125.000 - 250.000
250.000 - 375.000
> 375.000
Country Boundary
N
W
E
S


Albania
Primary road network
Total annual cost
LEGEND
Total annual cost (€/corridor)
< 1000
1000 - 125.000
125.000 - 250.000
250.000 - 375.000
> 375.000
Country Boundary
N
W
E
S

Albania

01 Milo				
02 Q. Q				
03 Milo				
04 Tirar				
05 Durr				
06 Tirar				
07 Fier				
08 Sara				
09 Elba				
10 Lush				
11 Rrog				
12 Shkc				
13 Milo				
14 Vlore - Sarande	131		✓	✗
15 Pogradec - Korce	69			

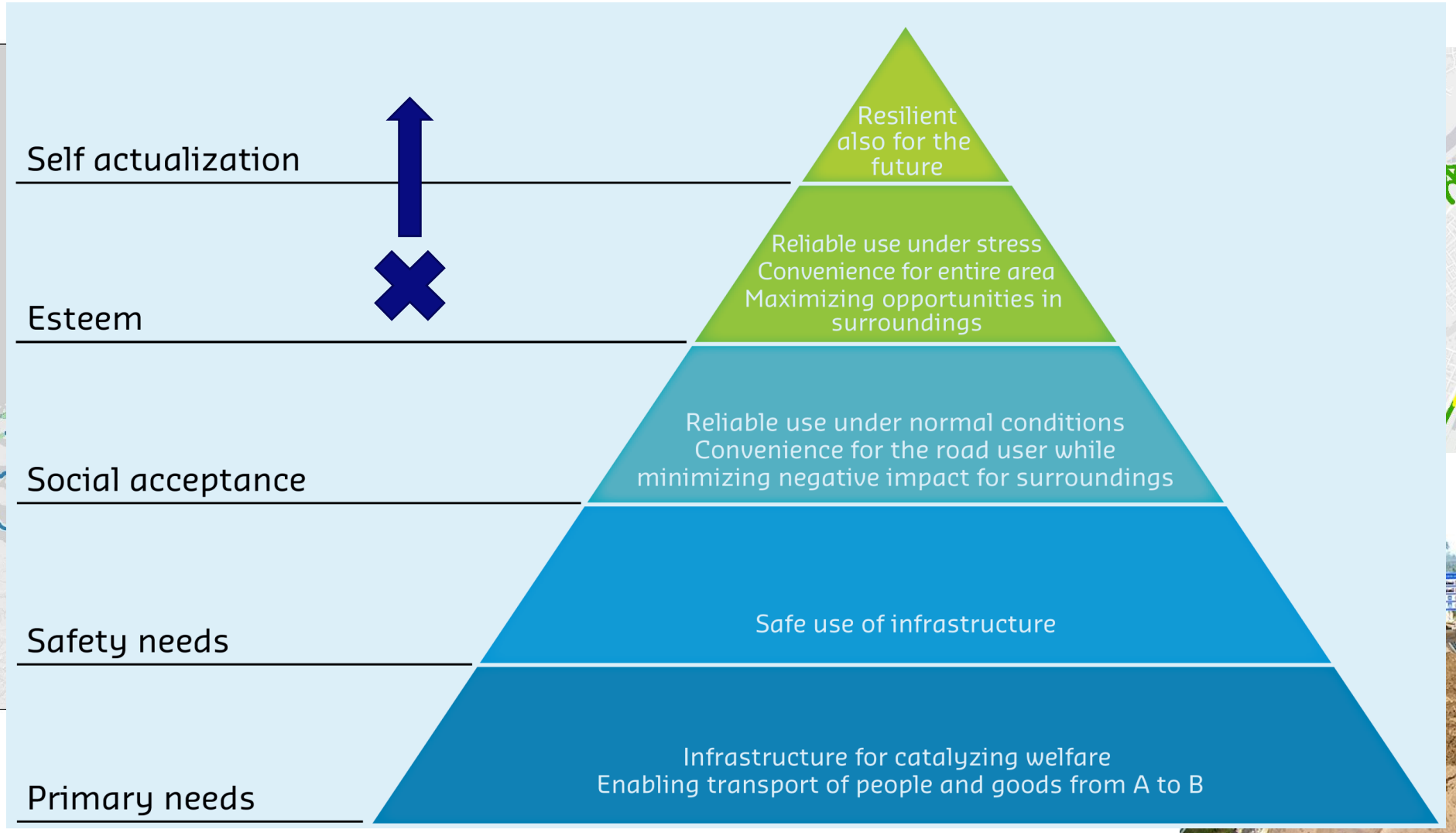


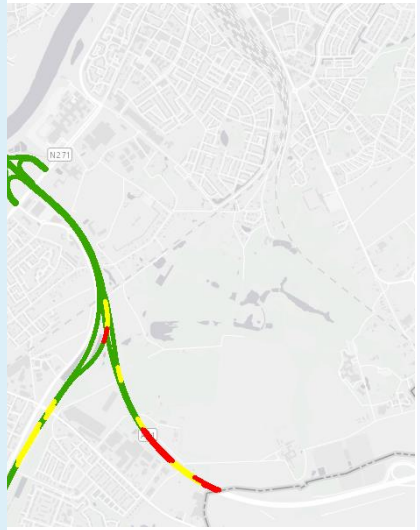
positive economic
nt

positive economic
nt under specific

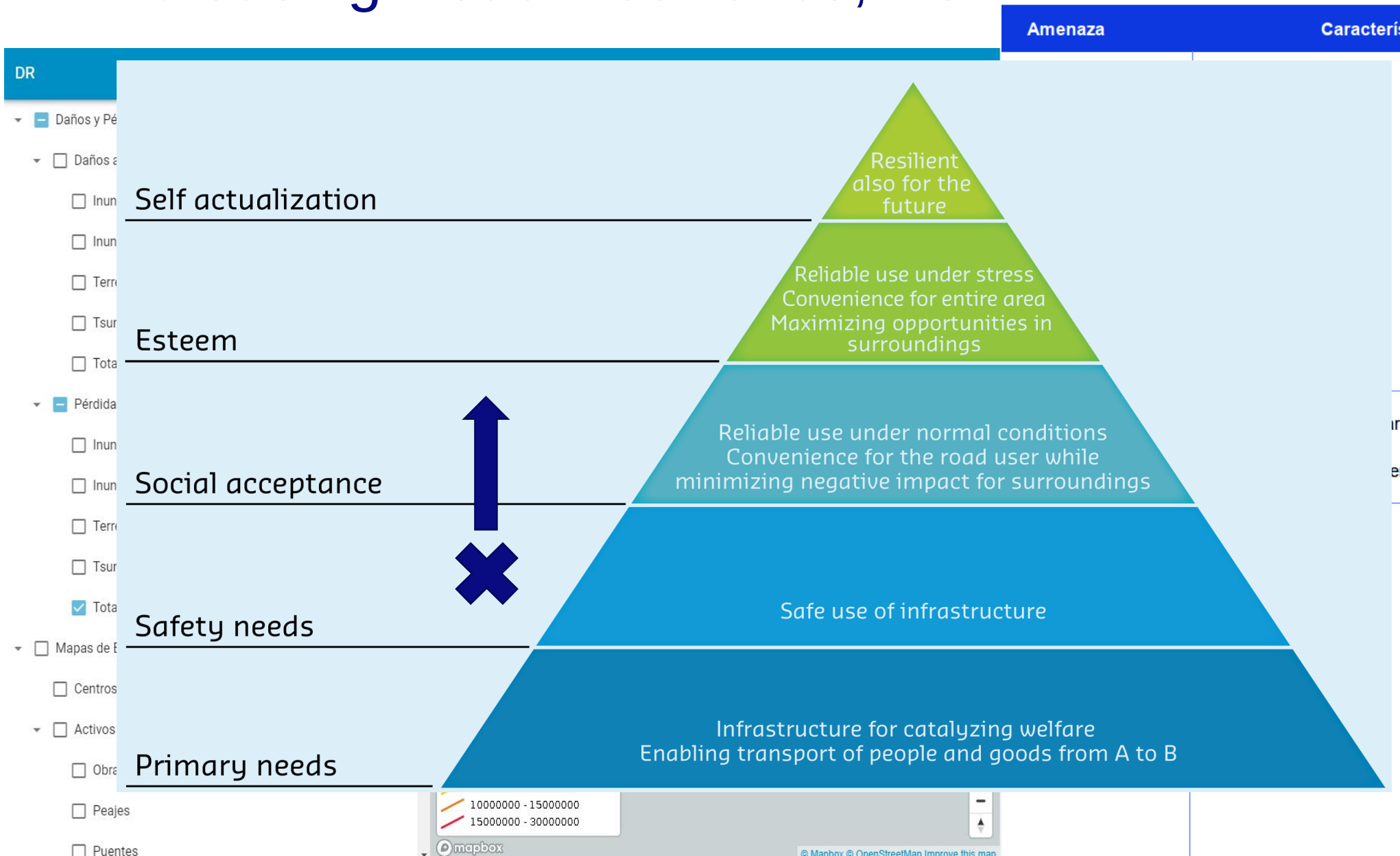
negative economic
nt

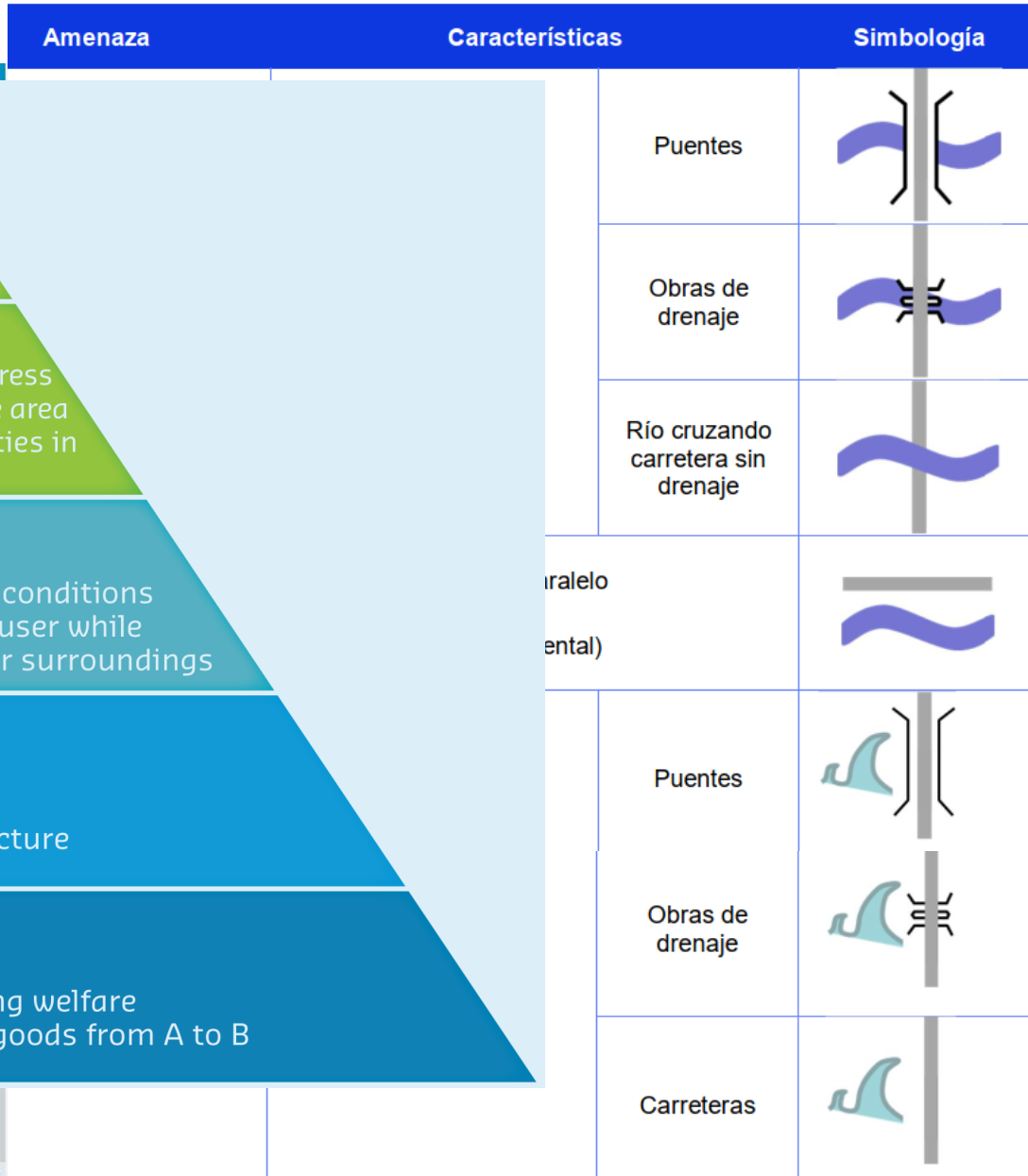
Climate Proof Networks, the Netherlands





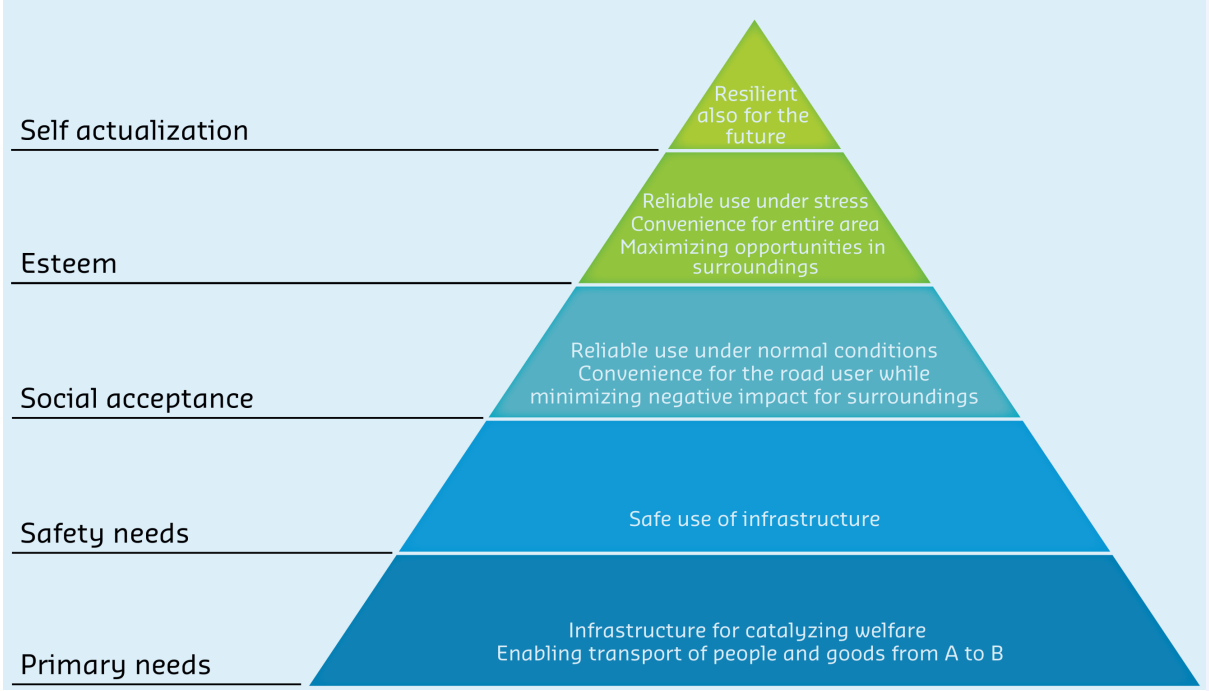
Increasing Road Resilience, Dominican Republic





Take (stay at) home message

- Road infrastructure vital for society
- Very dynamic environment
- Need to increase resilience



- Different analysis approaches exist
- Necessary to think about institutional development level when deciding for an approach

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