Geothermal Energy for Road Surface Heating in Winter Times

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Origin: Eugster, 2007

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1. MOTIVATION

Winter Service

adverse surface conditions reduce traffic safety and capacity

authorities clear roads to avoid restrictions

Challenges

vehicles cannot be at every point at the same time

to know, when and

where activity is needed

1. MOTIVATION

Approaches

preventive salting (especially with 100 % brine)

automated spray technology

heating of road surface …

Expected Advantages

avoidance of capacity / safety restrictions

reduced environmental impact

Origin: Schulz, 2012

2. GEOTHERMAL UNIT

Geothermal Energy

near surface sufficient for tempering road surfaces

closed and open systems

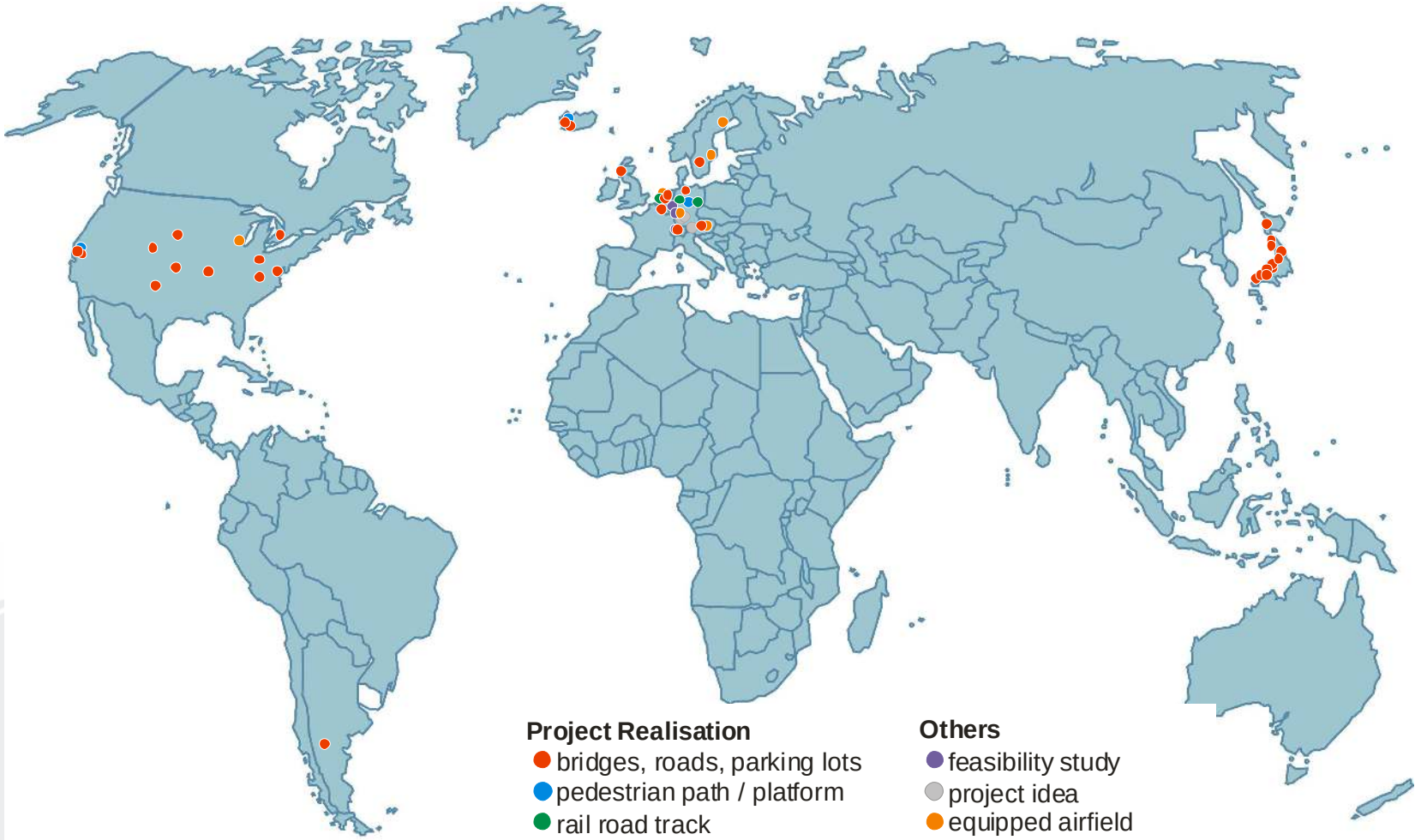
closed systems widely independent from location

Existing Technologies

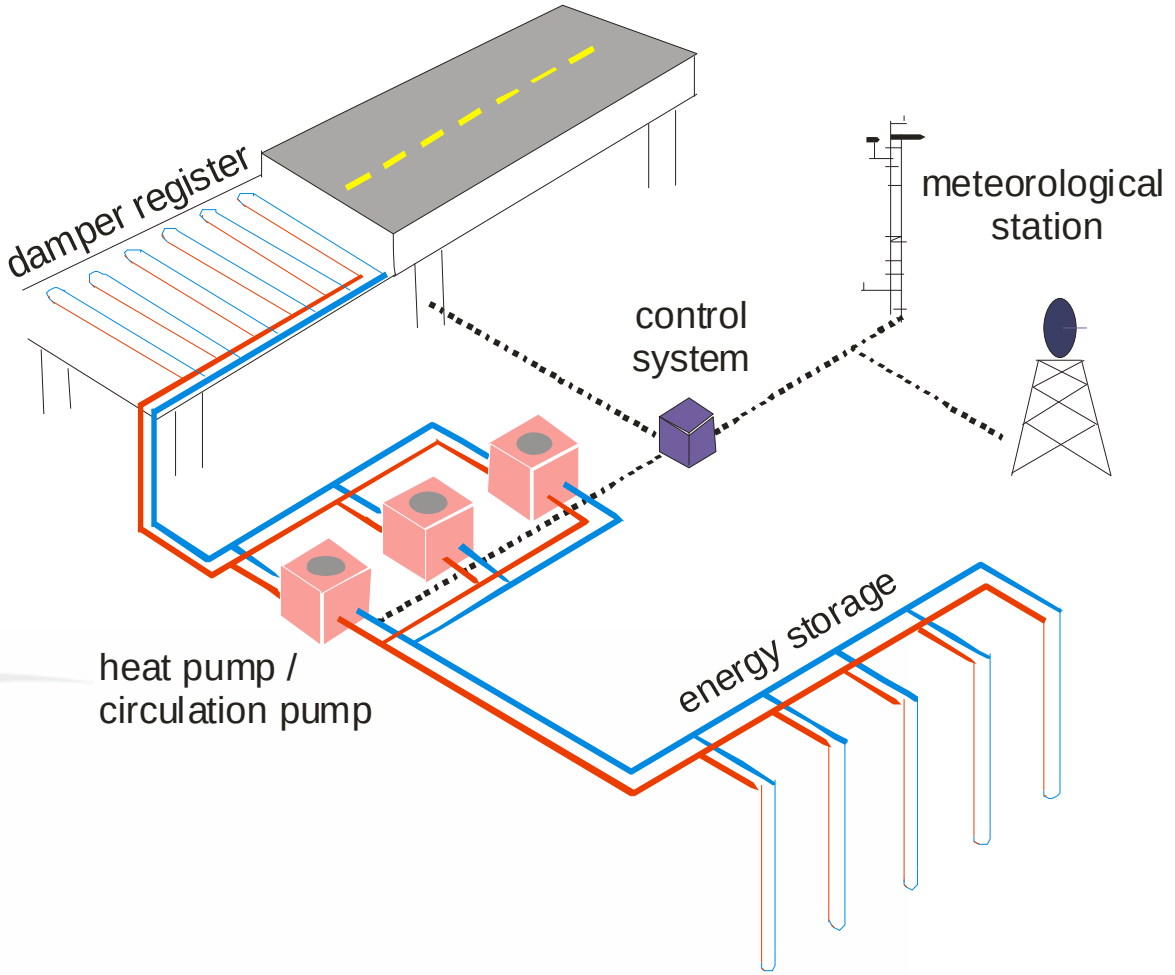
borehole heat exchanger / heat collector (closed systems)

ground water piles / hydrothermal sources (open systems)

2. GEOTHERMAL UNIT



2. GEOTHERMAL UNIT



Origin: OSU “smart bridge” (modified)

3. DATA COLLECTION

Influences

road network characteristics

weather (temperature, humidity, ice detection)

traffic (automatic counters, radar stations)

Experience

investment and operation costs of installations

energy availability and consumption, number of working hours

3. DATA COLLECTION

Winter Maintenance Activities

surveillance and road maintenance depots

number and distribution of dangerous points

salting activities

Findings

evaluation of past activities

simulation of activities with installations

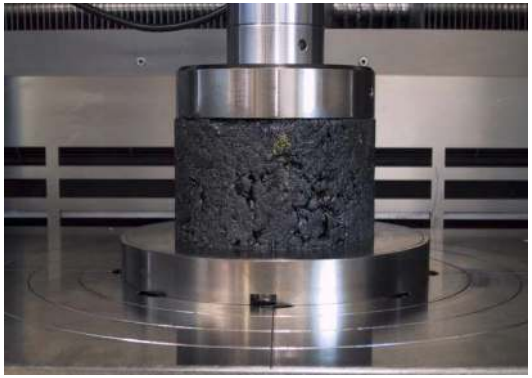
3. DATA COLLECTION

Ecology

salt consumption

traffic and environmental costs

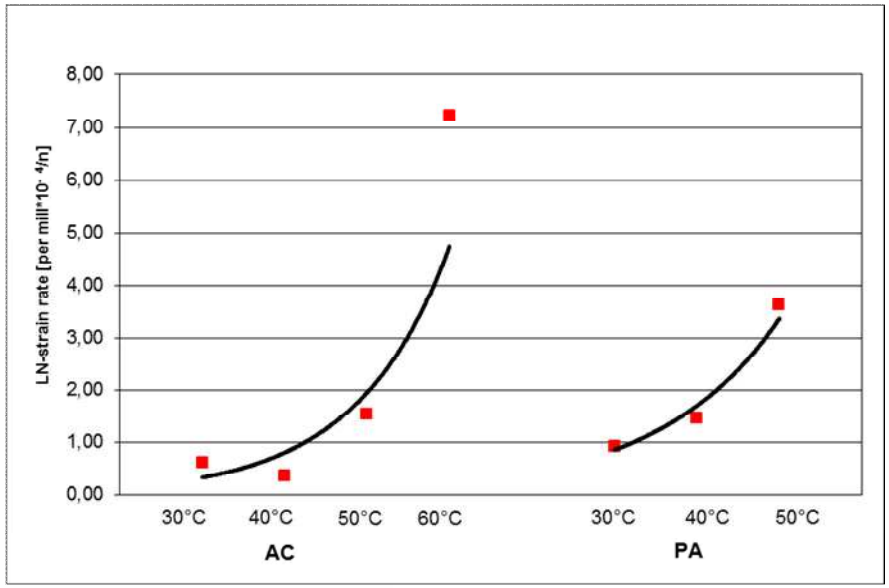
carbon dioxide emission



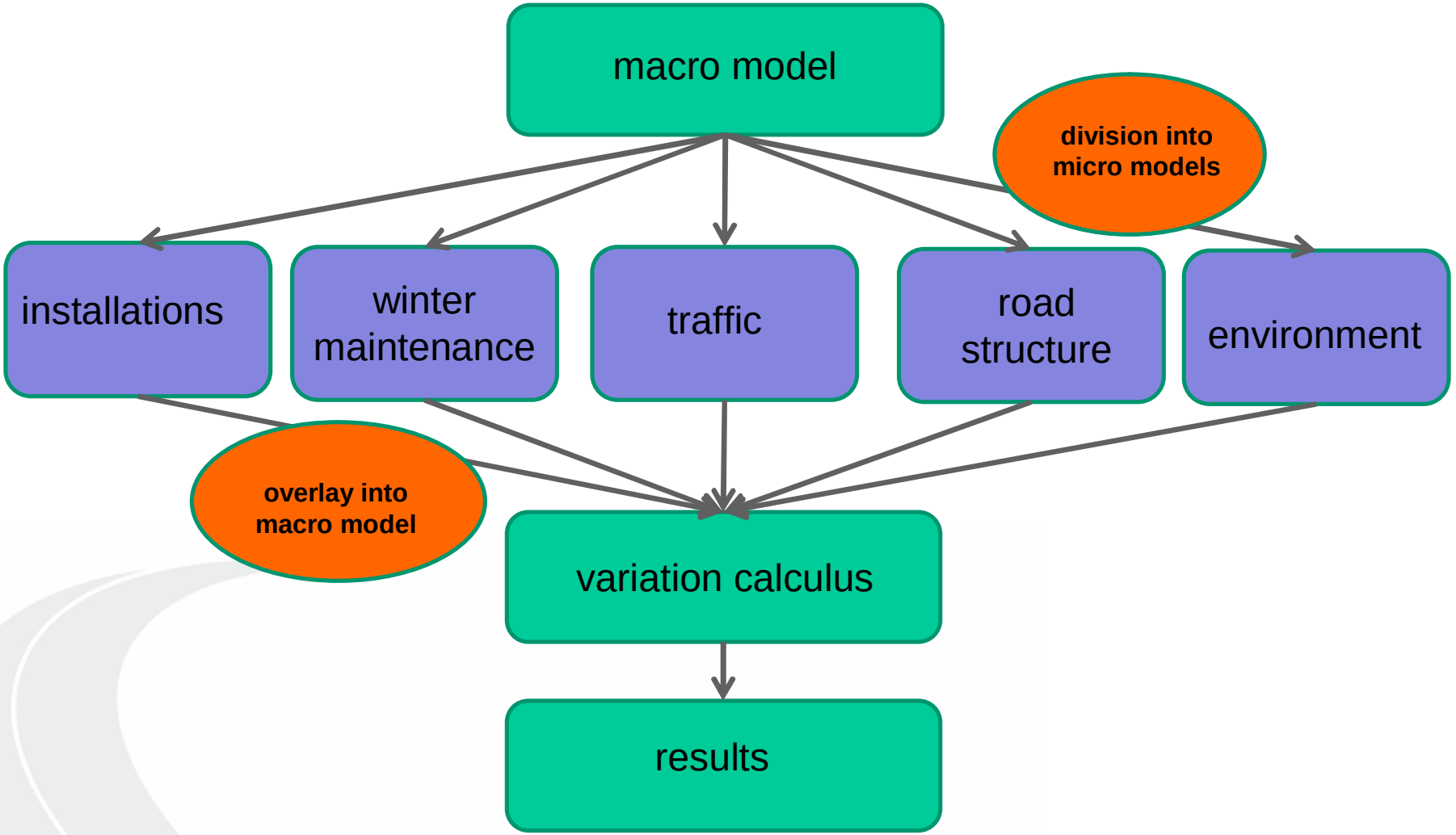
Structure

laboratory tests, to examine

temperature span in pavement layers



4. CALCULATION MODEL



4. CALCULATION MODEL

Balancing in three different levels of

investment and operation costs

traffic and environmental costs

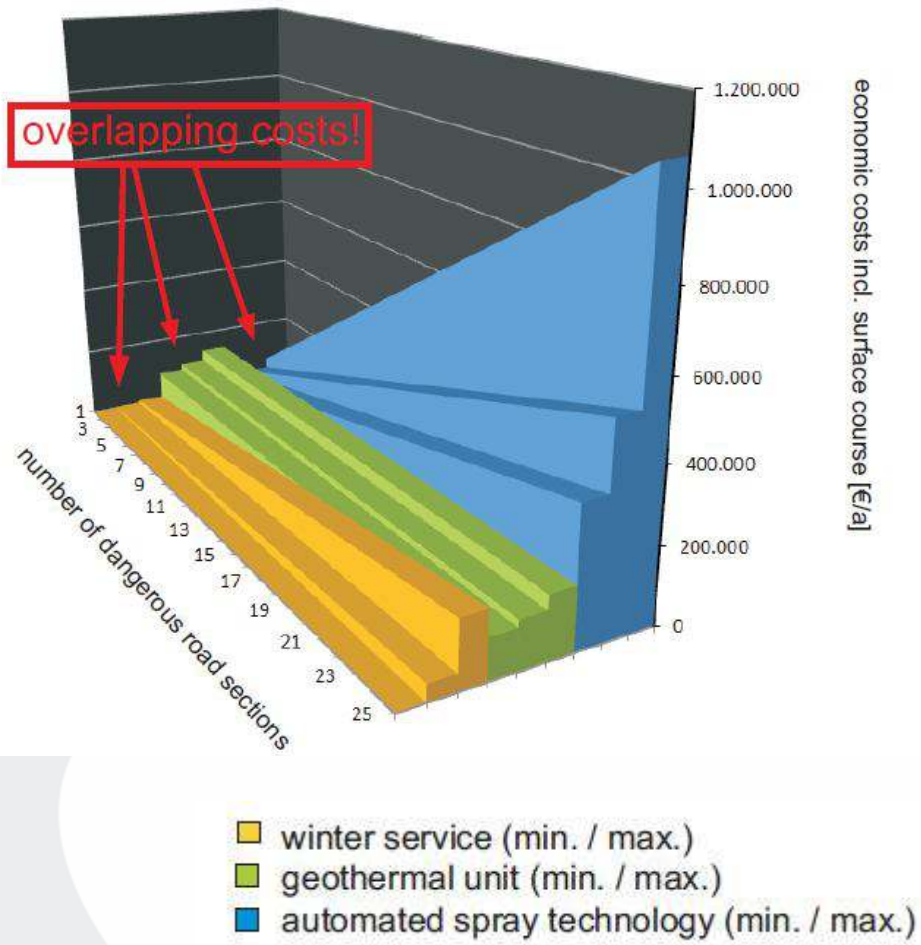
salt consumption and carbon dioxide emission

Evaluation of results concerning relationships with

number of dangerous spots

total pavement area of all dangerous spots

4. CALCULATION MODEL



Business Costs

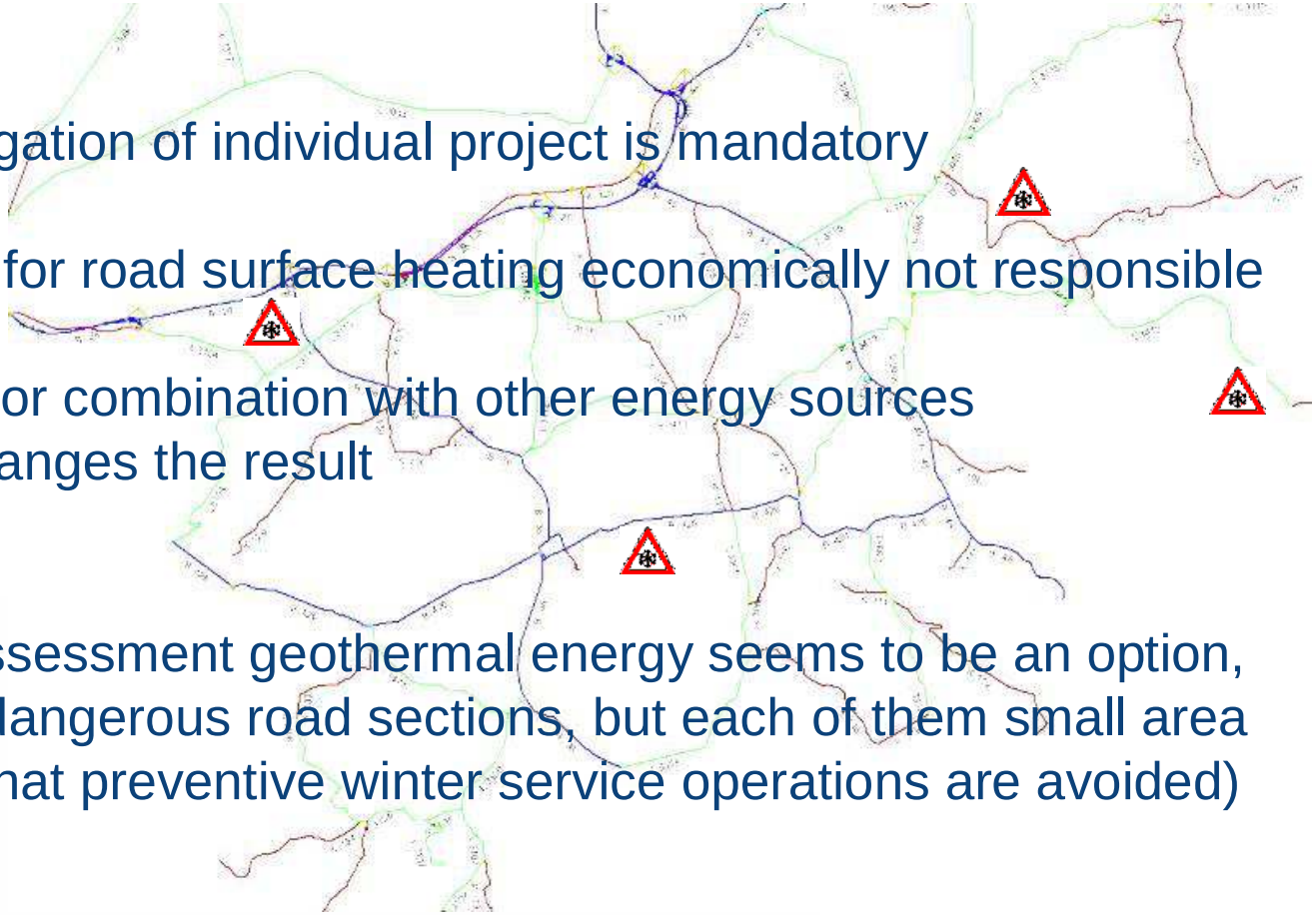
including replacement of the surface course

for a

total area of equipped pavement at all dangerous points of 10.000 m²

5. CONCLUSION

Conclusion



very detailed investigation of individual project is mandatory

geothermal unit just for road surface heating economically not responsible

heating and cooling or combination with other energy sources respectively user changes the result

in a network wide assessment geothermal energy seems to be an option, if there are several dangerous road sections, but each of them small area (and distributed so that preventive winter service operations are avoided)

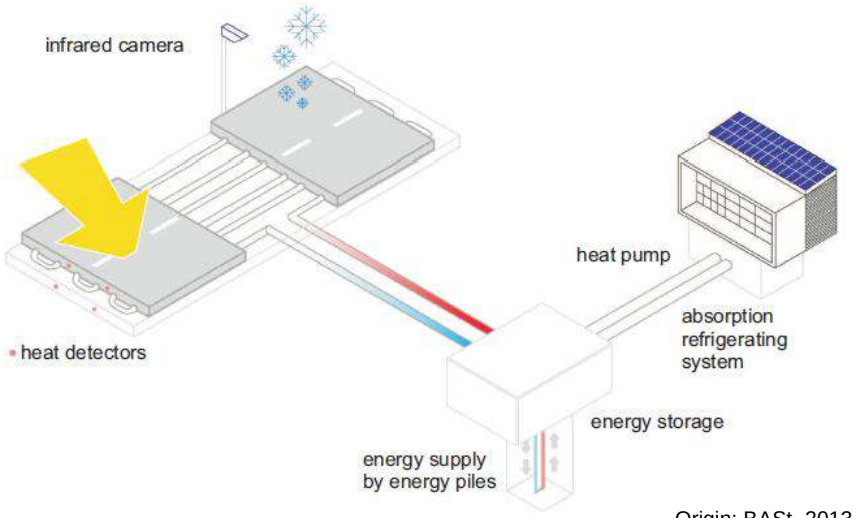
5. CONCLUSION

Recommendation

prolongation of lifetime with cooling in summer avoids maintenance

cooling in summer produces more energy than needed for heating in winter

Development of an extended system powered by renewable energy!



Origin: BASt, 2013