

Environmental aspects of de-icing technologies

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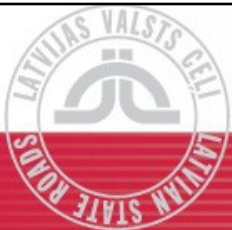
De-icers are evaluated by:

- Functional properties (objective)
- Direct expenses (objective)
- Byeffects (some are unpriced)



Breakdown of costs and benefits

COSTS	BENEFITS
<p>Direct (technological):</p> <ul style="list-style-type: none">• Material cost• Equipment cost• Labour cost	<p>Direct (to road user):</p> <ul style="list-style-type: none">• Fuel savings• Travel time savings• Minimize probability of road accidents
<p>Indirect (to society):</p> <ul style="list-style-type: none">• Cost to infrastructure• Cost to vehicles• <u>Cost to the Environment</u>	<p>Indirect (to society):</p> <ul style="list-style-type: none">• Reduction in macroeconomic losses due to higher traffic safety• Maintain the economic activity• Maintain access to social activities and emergent needs



Environmental concern of de-icing by DPSIR model

- Driving forces (D) – social needs for effective and safe mobility
- Pressure (P) – exposure of de-icers
- State (S) – primary influence (changes in natural balance)
- Impact (I) – condition of several environmental subjects
- Responsibility (R) – management of ecologic consideration

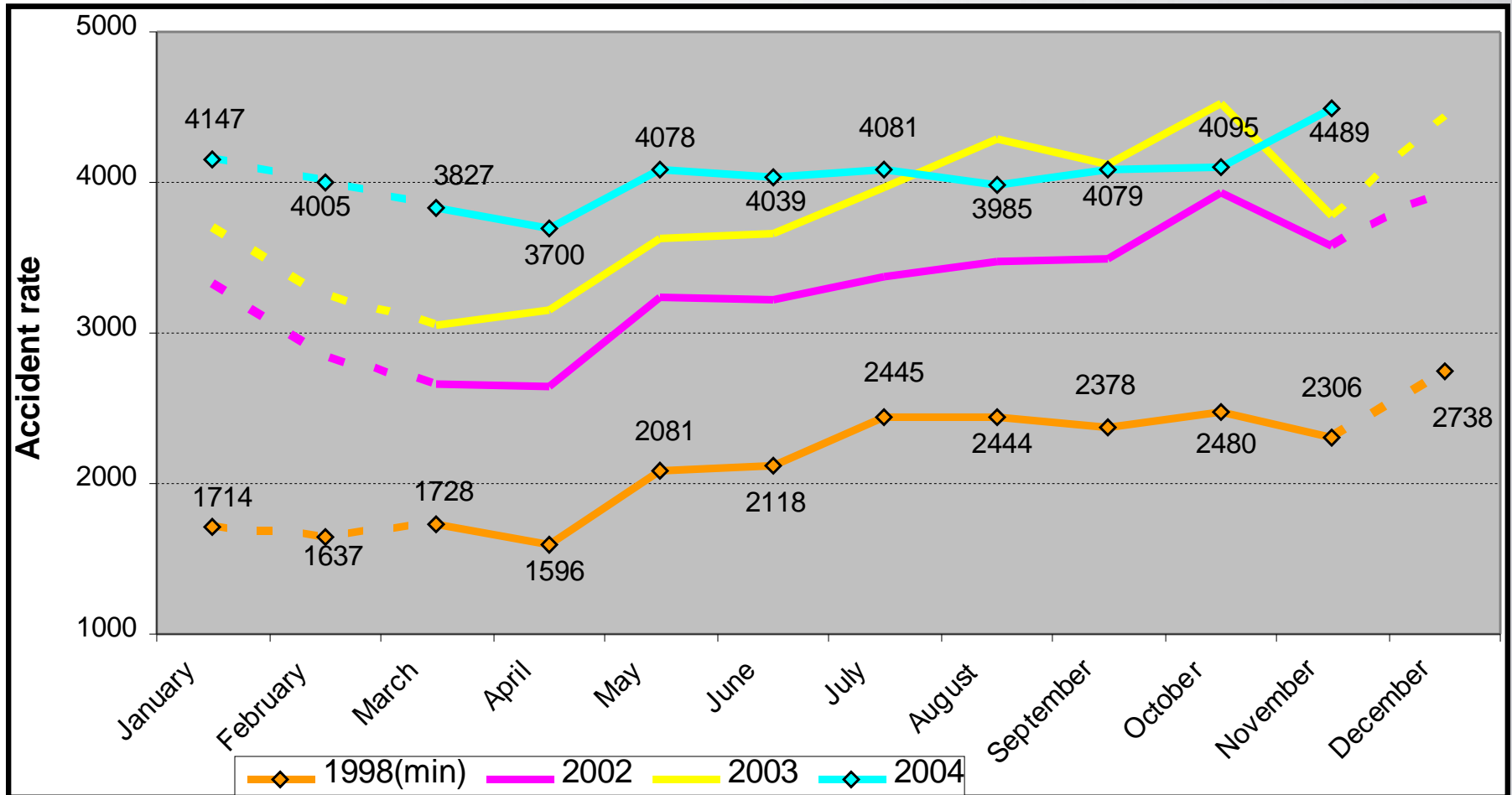


Principles of environmental approach to road de-icing

- Collaboration between road authorities, ecologic institutions and NGO
- Acceptable compromise between desirable service level, environmental concern and financing
- Sustainability (high mobility must not degrade the environment)



Accident rate on Latvian roads

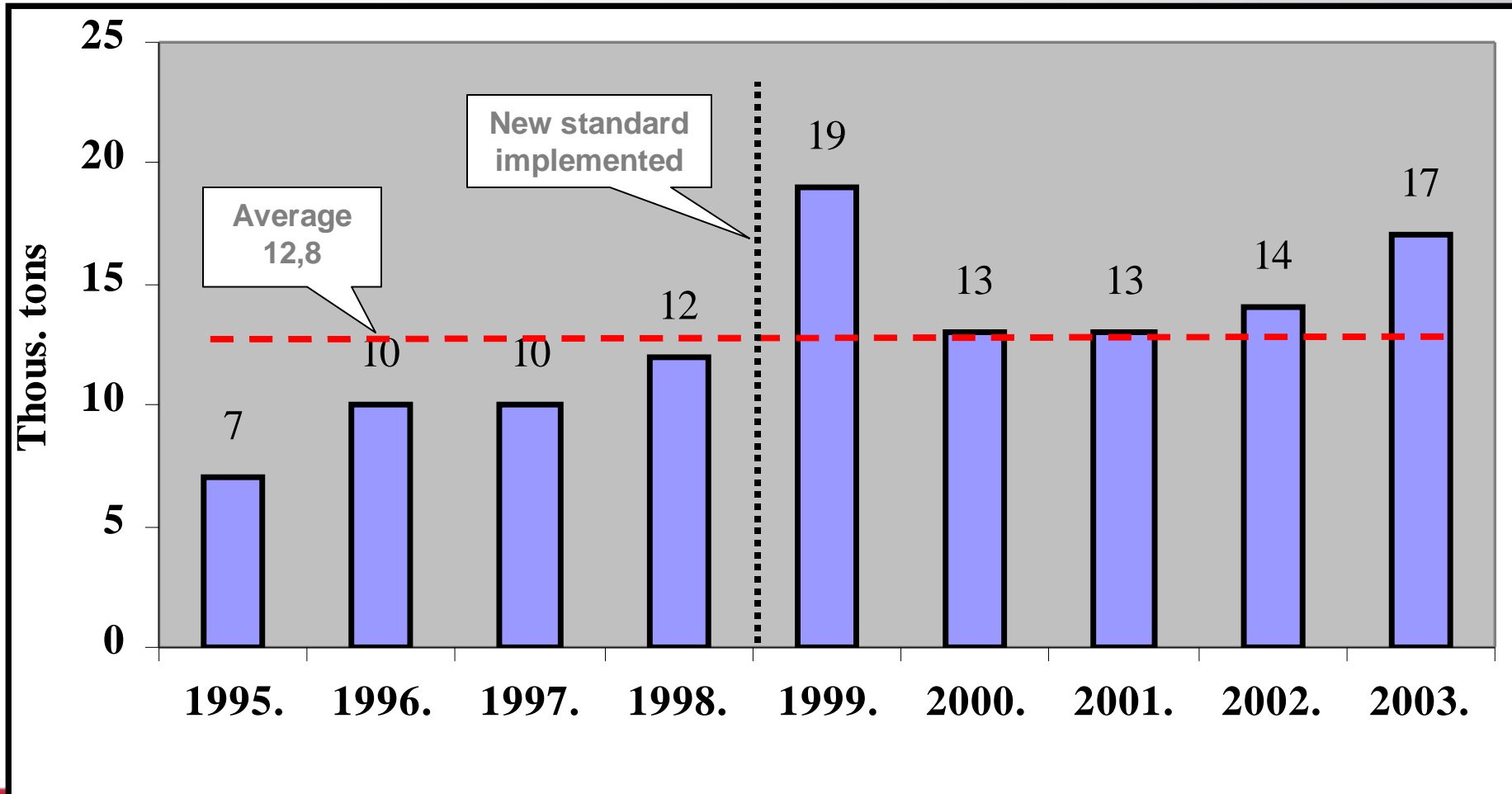


De-icing technologies, specified for Latvian state road network

De-icing technology (by used material)	Consumption of materials at a single treatment, g./m. ²	Effective in climatic conditions
sand/salt mixture (9/1)	190 – 320	-6°C > t > -10°C, continued precipitations
sand or crushed aggregate	320	t < -10°C
Prewetted salt (NaCl)	5 – 30	t > -10°C, black ice, freezing rain, frost, snow
Solution (NaCl, CaCl ₂)	15	t > -3°C, black ice, frost
Ice grinding	-----	t < -8°C, snowpack on the road



Annual consumption of road salt in Central Region of Latvia



Problems

- Greenery in road band (especially for urban areas)
- Potential localized problems with surface water (well's pollution)
- Large - scale ecological risks still are not identified (due to short time of massive salting, since 1996.)



Principal alternatives

- Inorganic de-icers (NaCl , CaCl_2 , MgCl_2 , KCl)
- Organic de-icers (CMA, $\text{K}_2\text{C}_2\text{O}_4$, $\text{Na}_2\text{S}_2\text{O}_8$)
- Abrasives (sand, crushed aggregate, mixtures)
- Passive measures (studded tyres, speed limits etc.)



Overall consideration of de-icers

Area	Environmental impacts		
	Chlorides	Organic chemicals	Abrasives
Air	Practically don't affect	Realize CO ₂ , emit a specific smell	Relevant source of dust
Soil	Tend to accumulate and change natural chemical balance	Short-term effect due to decomposition	Form deposits
Water	Increase concentrations of corresponding ions	Absorb oxygen, contribute eutrophication of water courses	Don't affect
Roadside vegetation	Repress growth at high concentration	Practically don't affect	Practically don't affect
Overall impression	Impact on roadside vegetation	Can contribute problems of water courses, worse air quality	Worse air quality
Conclusion	Need to be restricted near the sensitive vegetation	Can not be advised as absolutely better alternative for salt	Effective on local roads, pathways and pavements at adverse weather conditions



Solutions

- Decreasing of road service level in winter (inacceptable)
- Minimization of annual salt consumption at present or even higher service level
- Special road greenery oriented measures



THANK YOU
FOR YOUR ATTENTION

