Reducing salt consumption by using RWiS and Mesoscale data

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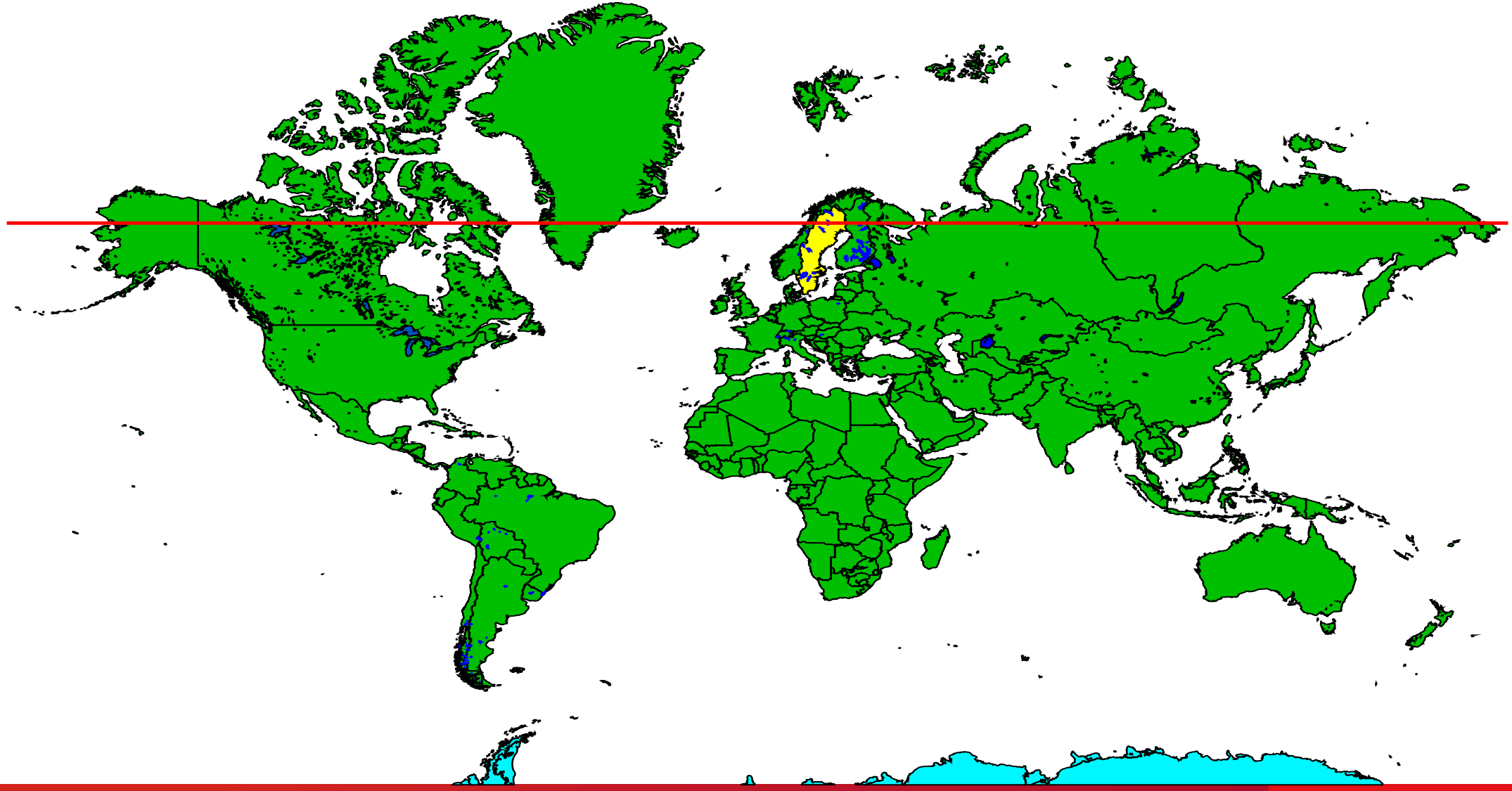
- Background
- Bases and theories behind the Salt Index
- Calculating occasions of snowfall conditions
- Calculating occasions of slippery road conditions
- Presentation of the salt index
- The Future



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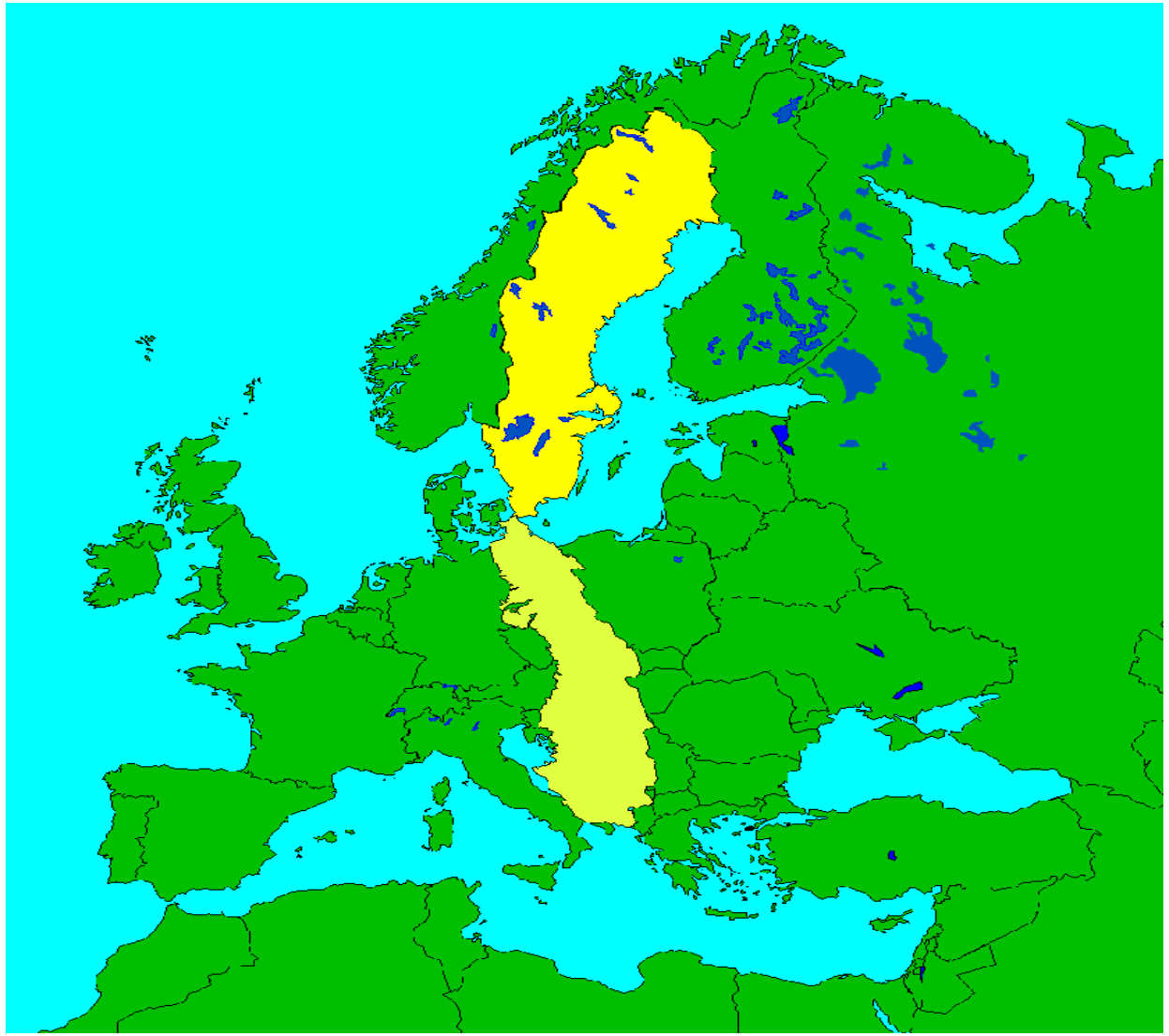
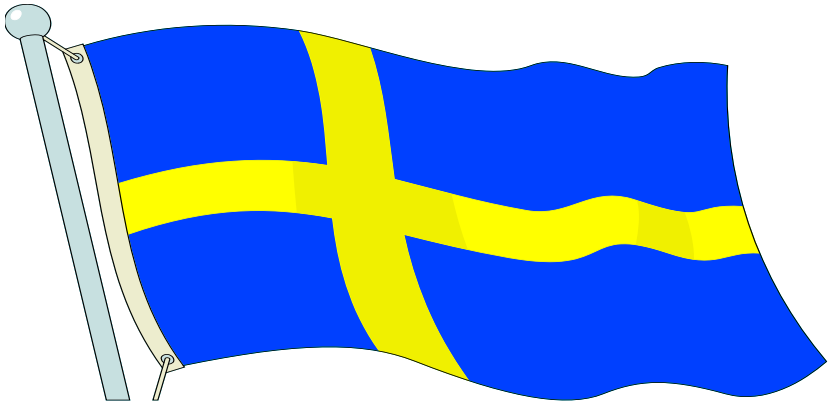




- The length of Sweden 1 572 km
- 98 000 km State roads
- 18 500 km salt roads (AADT more than 1 500)

For today's road authorities it is very important to keep track of the quantity of chemicals used in winter road maintenance.

Variations in snow and ice conditions from year to year make it difficult to compare figures.

In order to be able to describe these differences in a more objective way, the Swedish Transport Administration developed a Salt Index

RWIS stations in Sweden

Earlier:

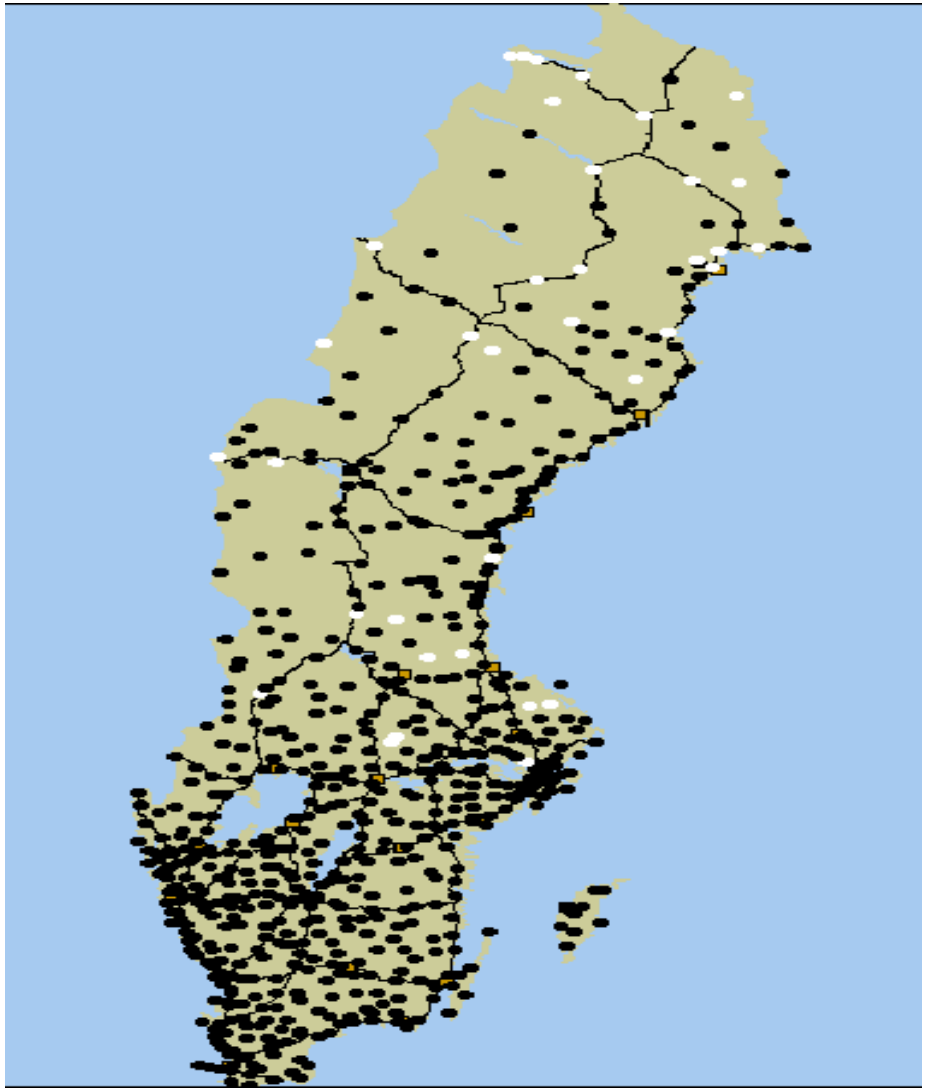
- **Decision-making tool for supervisors in winter road maintenance.**

Today:

- **Pay item for contractors**
- **Weather severity index**
- **Salt consumption index**
- **Cost effective index (ratio)**

Spin offs:

- **Higher accessibility**
- **More cost effective**

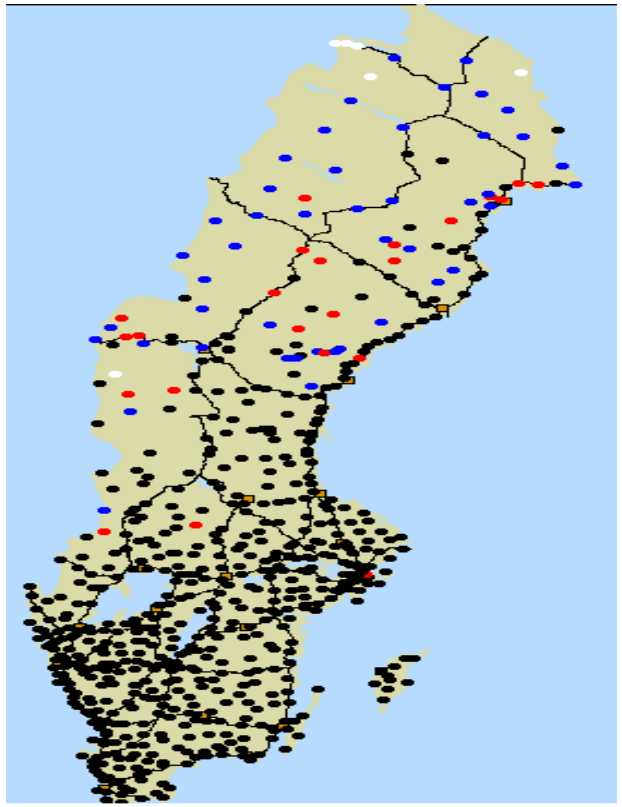


Salt index is based on data from 775 RWiS stations

Partly on Mesan data delivered from SMHI

And combined with the total amount of salt for winter road maintenance.

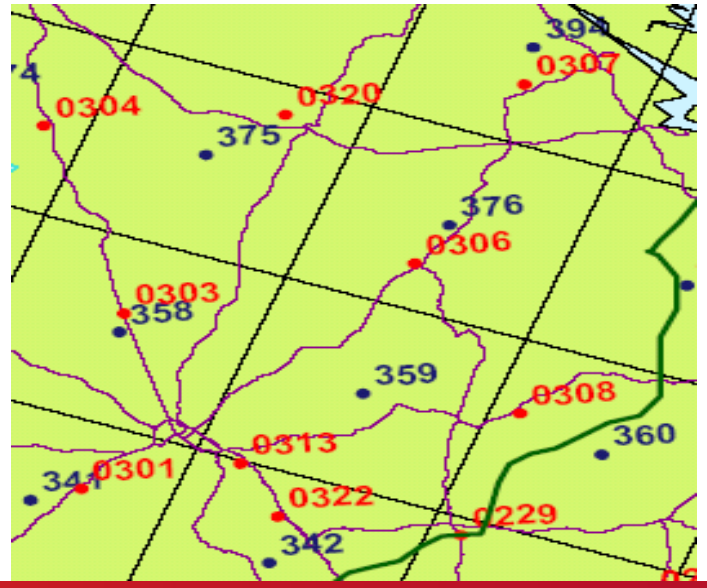
Basically, we use the RWiS for information on the air and road surface temperatures, humidity, and SMHI data for wind speed and the amount and type of precipitation.



The RWiS data is collected every half-hour and the SMHI data every hour.

To calculate the amount of precipitation, SMHI uses a model called Mesan, which is an operational Mesoscale Analysis System.

This model sub-divides Sweden into a 22 by 22 kilometre grid net, and calculations are performed for each grid individually.



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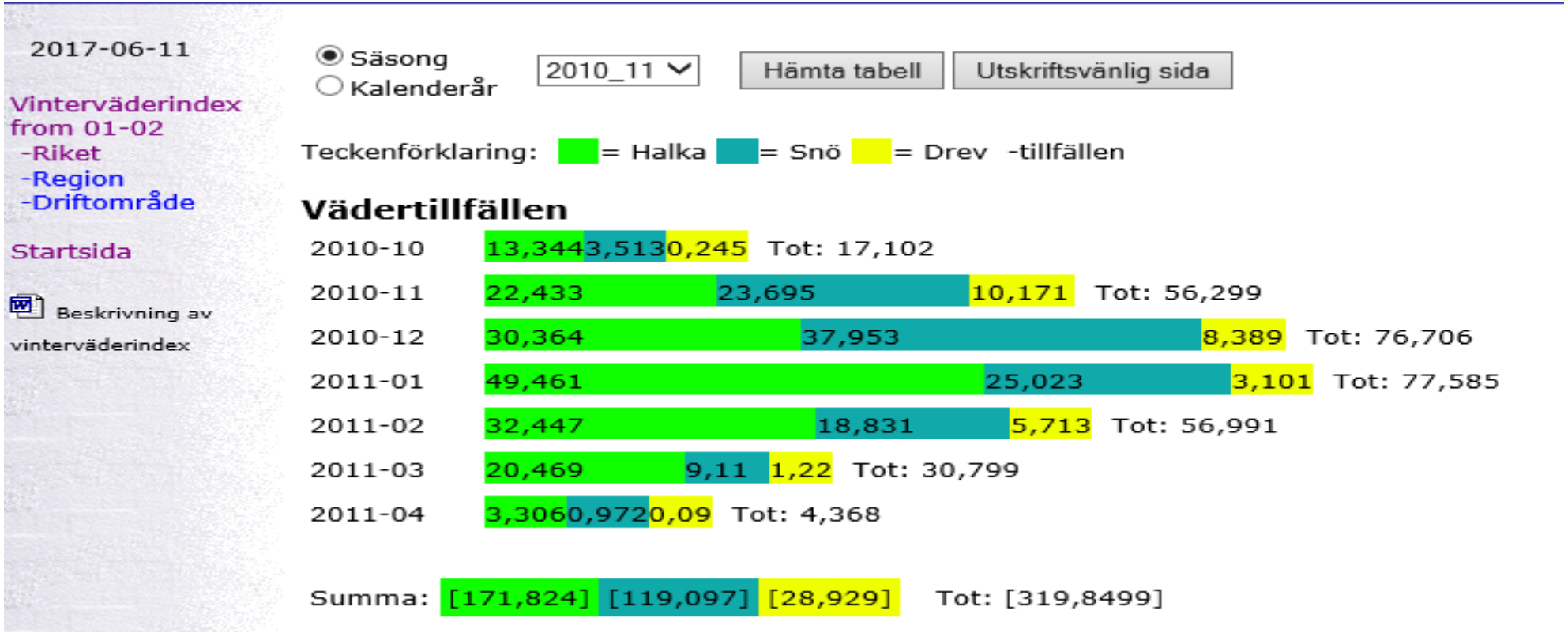
The total number of weather occations of slippery situations, snowfall and snowdrift is calculated every month during the winter season.



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Bases and theories behind the Winter Index

- ***Snowfall is divided into three categories (d = snow depth in cm)***
- **0.3 < d ≤ 1.0**
- **1.0 < d ≤ 2.5**
- **2.5 < d.**

- ***Slippery surface is divided into five categories.***
- **Slippery surface due to rain or sleet on a cold road (HN).**
- **Slippery surface due to damp/wet roads freezing over (HT).**
- **Slippery surface due to light precipitation (HS).**
- **Slippery surface due to light frost (HR1).**
- **Slippery surface due to heavy frost (HR2).**

Calculating occasions of snowfall conditions

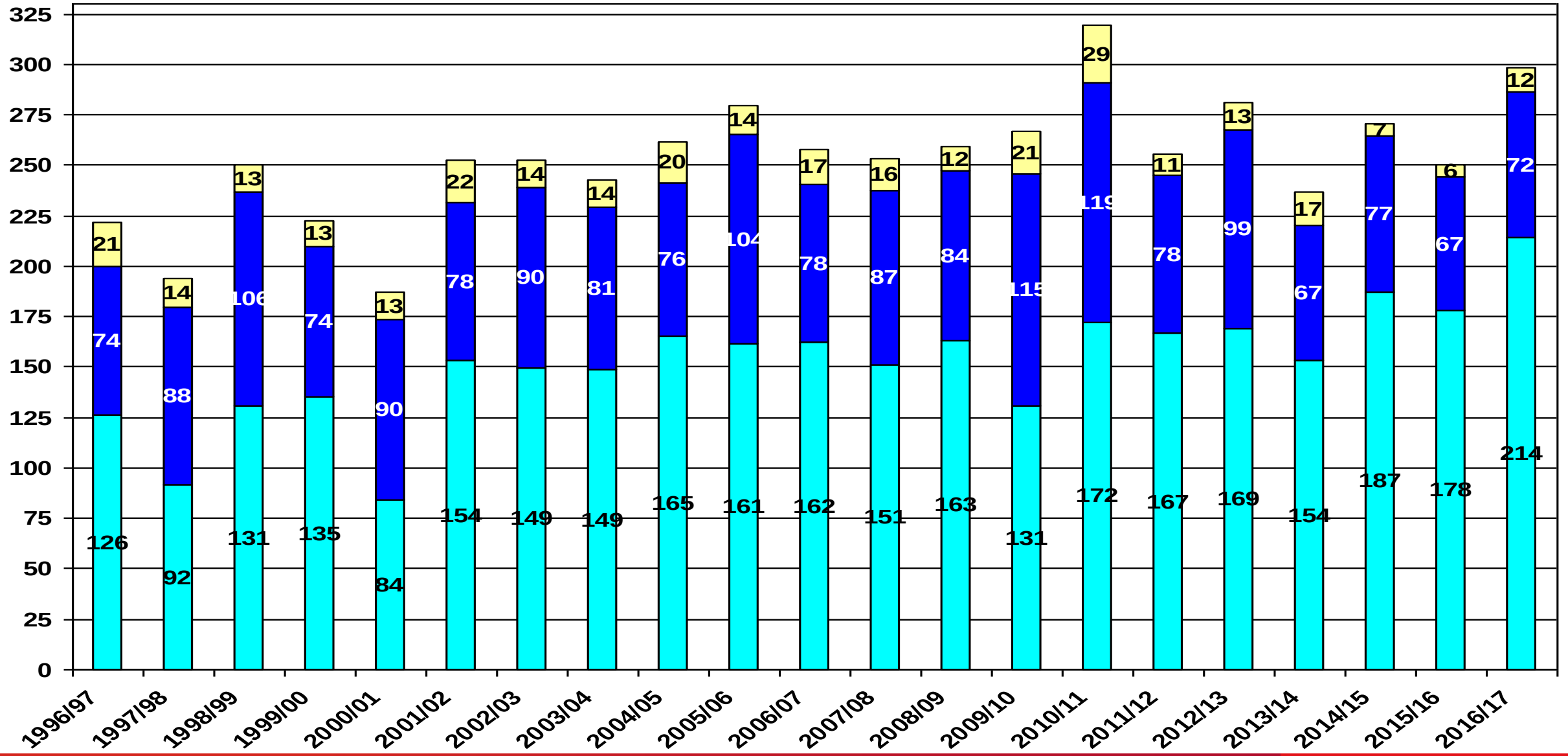
- **Snowfall is divided into 4-hour periods.**
- **class $0.3 < d \leq 1.0$ signifies a snowfall where it is expected that it will only be necessary to use salt to melt the snow.**
- **class $1.0 < d \leq 2.5$ signifies snowploughing on the high volume traffic network.**
- **class $2.5 < d$ signifies snowploughing on the low volume traffic network.**

Calculating occasions of slippery road conditions

- **Occasions of slippery surface conditions are those where RWiS data would theoretically mean hoar frost formation. This means that the figures are directly related to road climatology and not atmospheric measurements, which is the usual way of measuring.**

- **The data is the same as the contractors use for initiating actions for skid control.**

Mean value of weather situations requiring action in the entire country per season



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Presentation

Type of			(cm)
HR1/HS	HR2		SNOW3 2.51-
24	36		120

Vägverket
Swedish National Road Administration

Vägverket Produktion

Vägverket VUC

GUIDELINES

FOR DE-ICING

Roads, 7 metres width, = 2-lanes

Road Condi - dition	Forecas- ted surface temp °C	SPREADER ADJUSTING: Pre-wet salt: Width m	SPREADER ADJUSTING: Pre-wet salt: Quantity g/m²	SPREADER ADJUSTING: Salt-Solution: Width m	SPREADER ADJUSTING: Salt-Solution: Quantity g/m²	SALT-CONSUMPTION PER 10 KM: Pre-wet kg	SALT-CONSUMPTION PER 10 KM: S-Solution kg	Salt-solution Consumption per 10 km m³
Pre-wett salt, spread prior to temperature drop								
Dry or moist	0 -5	4	6	7	14	240	210	0,98
	-5 -10	4	11	7	23	440	350	1,63
Wet	0 -5	4	8	7	19	320	280	1,30
	-5 -10	4	13	7	28	520	420	1,95
Wet prior to snowfall	0 -5	4	21	-	-	840	-	-
	-5 -10	4	25	-	-	1000	-	-
Measures to be taken during snowfall. Combined operations. Risk of surface freezing.								
Snowfall 1 - 5 cm	0 -5	2x3	12	-	-	720	-	-
	-5 -10	2x3	18	-	-	1080	-	-
Snowfall > 5 cm	0 -5	2x3	18	-	-	1080	-	-
	-5 -10	2x3	24	-	-	1440	-	-
Measures to be taken on black ice in dry weather								
Formati- on of ice	0 -5	4	11	7	23	440	350	1,63
	-5 -10	4	15	7	33	600	490	2,28
Thin ice	0 -5	4	21	7	47	840	700	3,26
	-5 -10	4	25	7	56	1000	840	3,91
Thick ice	0 -5	4	25	-	-	1000	-	-
	-5 -10	4	25	-	-	1000	-	-
Measures to be taken on freezing rain								
Formati- on of ice	0 -5	4	32	-	-	1280	-	-
	-5 -10	4	42	-	-	1680	-	-

Determation of the salt quantities

Main- points to think of

- Earlier measures taken
- Time of day or night
- Day of the week
- Temperature forecast
- Precipitation forecast
- Trafik structure
- Type of surface
- Access to methods

PLEASE NOTE!

No salt spreading during snofall without plow attached.
Limit use of salt during snowstorm.

Recommende
2-lane road du
based on the

Calculation of salt index

- Salt consumption during the period for the area in question.

- Kilometres of road treated with salt. For motorways and 4-lane roads, both directions are counted.

- Number of HR1, HS, HR2, HT, HN, snowfall and snowdrift occasions as per the following table for the area in question.

- Salt dosage values based on the STA Guidelines for De-Icing

$$\frac{\left(\frac{\sum \text{Salt consumption, kg}}{\sum \text{Length of road salted, km}}\right)}{(\sum \text{HR1} + \text{HS} * 24) + (\sum \text{HR2} * 36) + (\sum \text{HT} * 48) + (\sum \text{HN} * 60) + (\sum \text{SNOW1} * 36) + (\sum \text{SNOW2} * 90) + (\sum \text{SNOW3} * 120)}$$

This provides a good basis for comparing salt consumption from year to year and a possibility to find areas where they use to much salt compared to the weather.

When we found maintenance areas that had a salt index much higher than acceptable, we wanted to find out why?

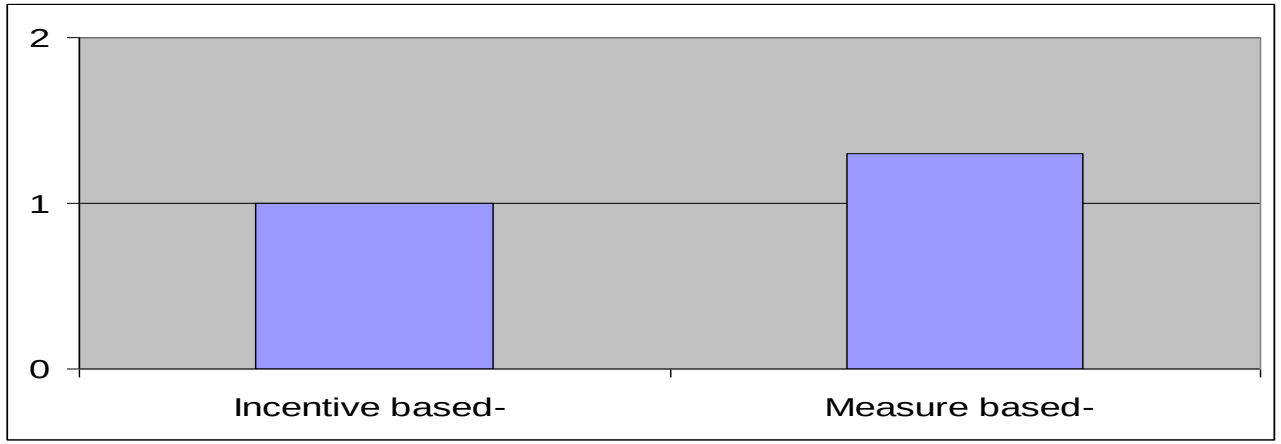
An analyze of maintenance cost and benefits in total gave by the hand some interesting results concerning winter maintenance.

The answer was found in the way the contractors were compensated for their maintenance activities.

An incentive based compensation to contractors

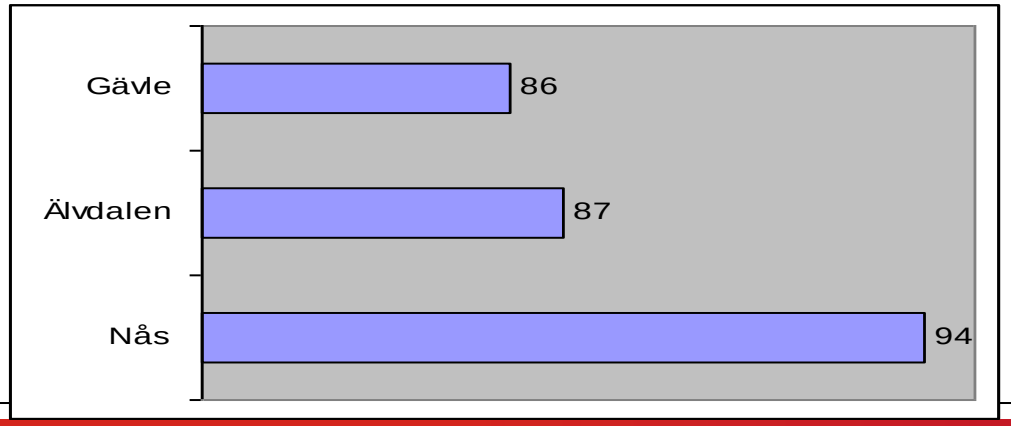
ives the following results:

Salt index close to 1,0 for incentive compensation indicates optimal use of salt



Positive effects after transition from measure based to incentive compensation

Cost before transition =index 100



- **No negative results in accident statistics have been found after introdiction of incentive compensation**

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An incentive based compensation to contractors have the following advantages:

Creates motives to improvement

” We are now looking after tecnical developements- thanks to the compensation system”

Reduces the motives for overutilization

” Otherwise we might just have made an maintenance action - It might get slippery. Now we make a more accurate grading before action”

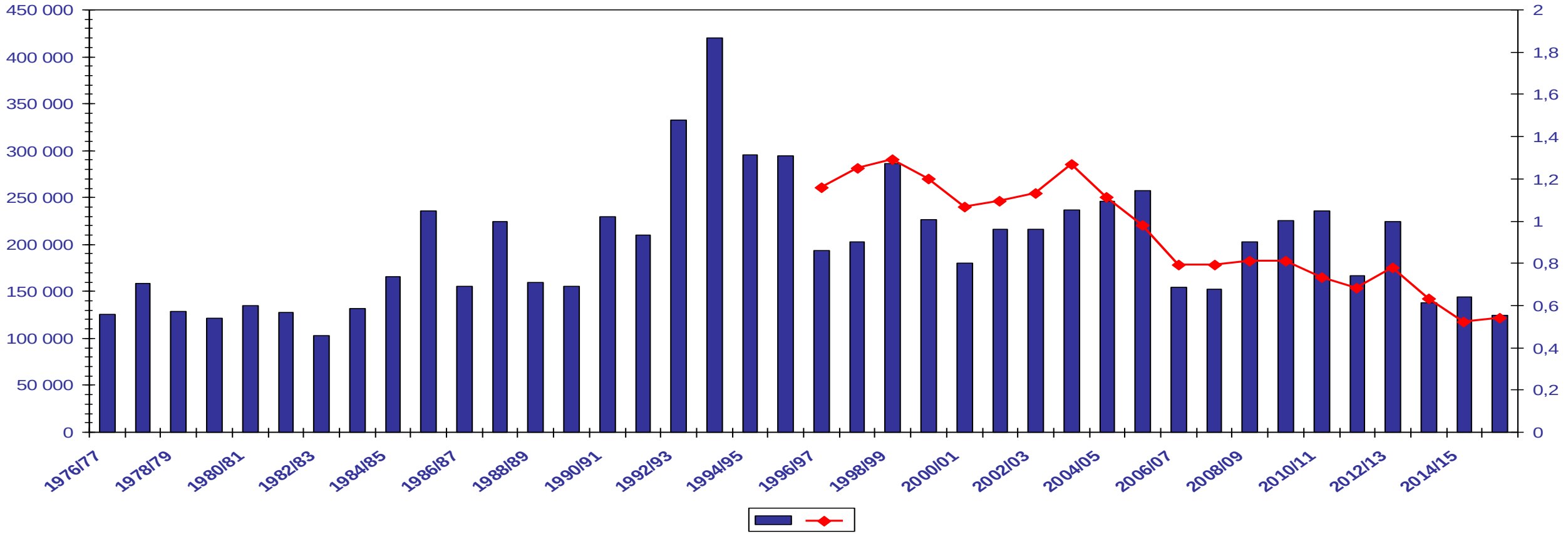
Simplifies administration

” The contractors don´t need to fill in a lot of papers that I in the next step have to put together”

The use of an incentive based compensation model built on RWiS and MESAN-data gave as a result a reduced use of salt compared to a compensation model based on measures.

The results where so obvious that Swedish National Road Administration changed the whole compensation system before the winter season 2005-2006.

Salt consumption and salt index for the entire country



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Thank You for your attention!