Intro to tech and company

CARBON CRUSHER

Bioinginerie pentru un viitor durabil: aplicații practice ale biotehnologiilor moderne în reducerea amprentei de carbon

2 unique advantages with our technology

Proprietary Crusher

- Crushes the road to a homogenous mass, 25 cm deep
- Can crush through asphalt, rock, mountain
- Eliminates need for additional gravel added to the road

Lignin binder

- More flexible than bitumen – better resist thaw damage
- Sustainable – binds carbon in the road
- Completely safe to use for all stakeholders


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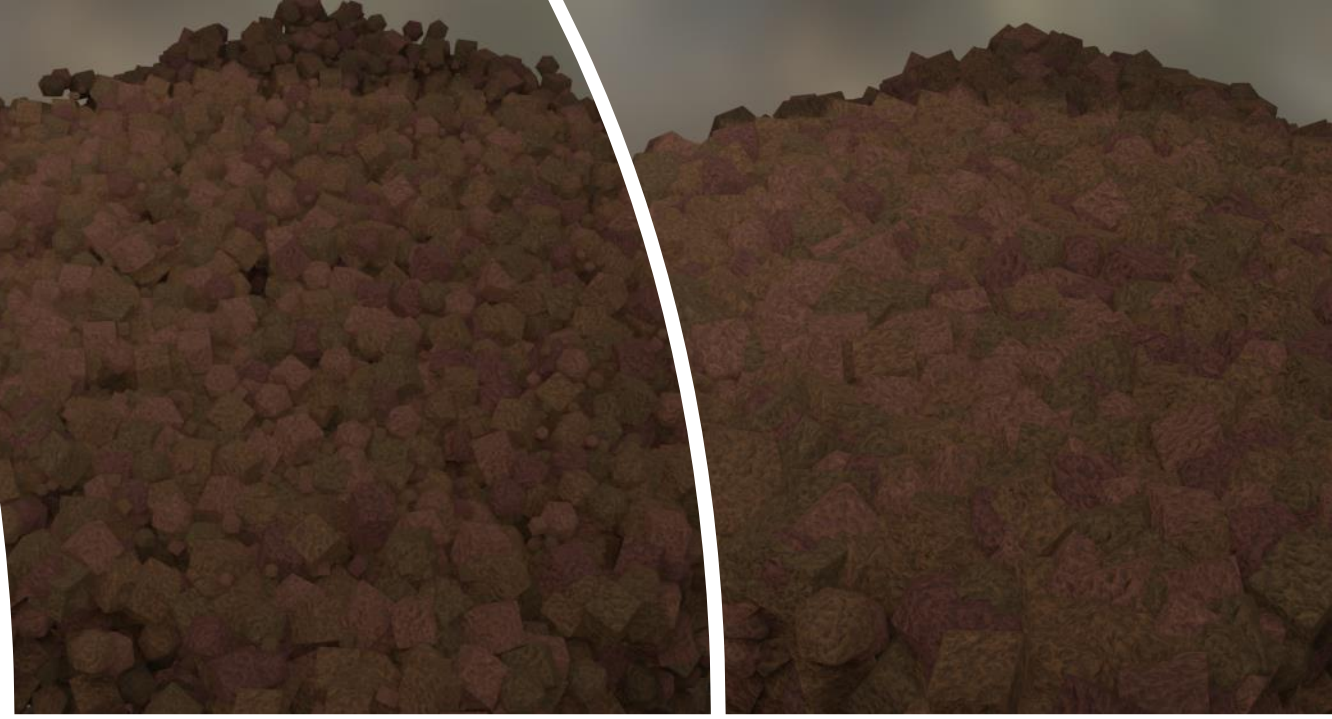
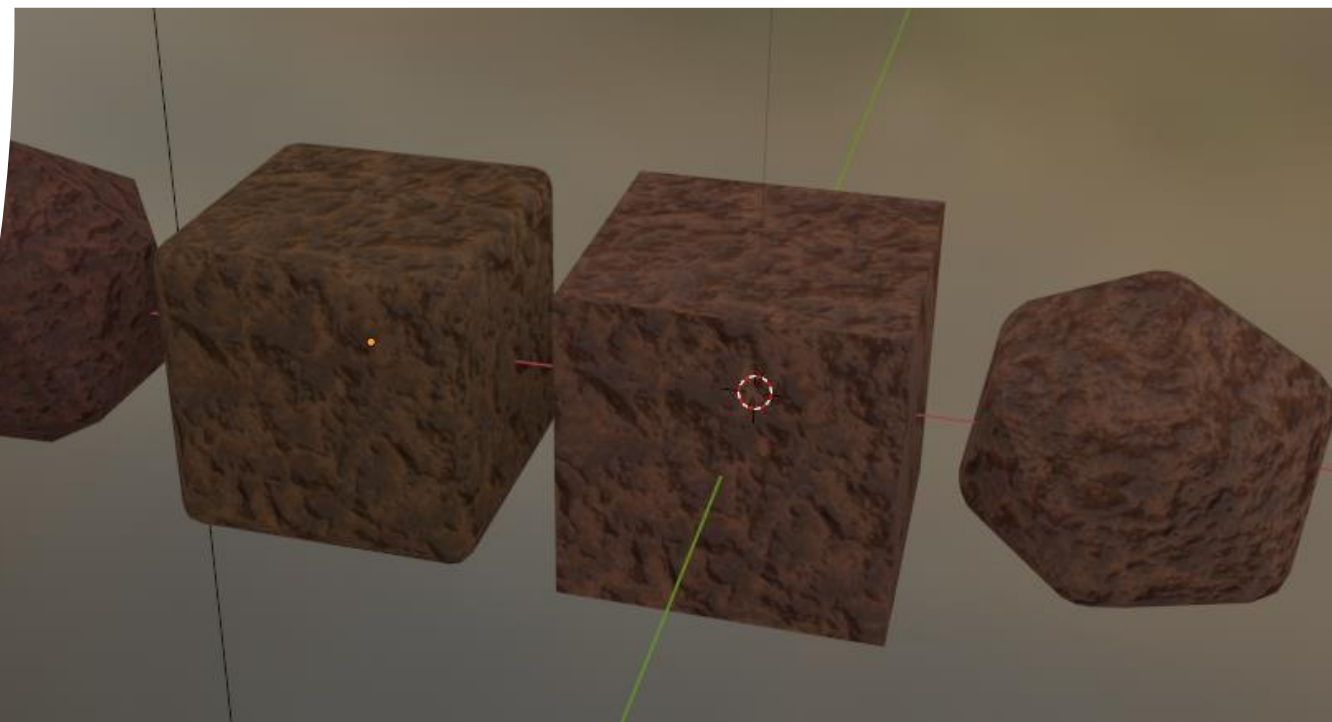
Image synthesis

- To test whether it is possible to extract size information from images, we decided to begin synthesized depth images, the intuition being that depth information is directly correlated with particle sizes
- By doing preprocessing the image to remove camera distortion and doing a frequency analysis we found that we are reliably able to separate images generated using either 10mm, 20mm, or 30mm particles.
- Made 4 sample stones of size roughly 10mm. By scaling and duplicating them, we can approximate what a crushed road will look like with different sizes





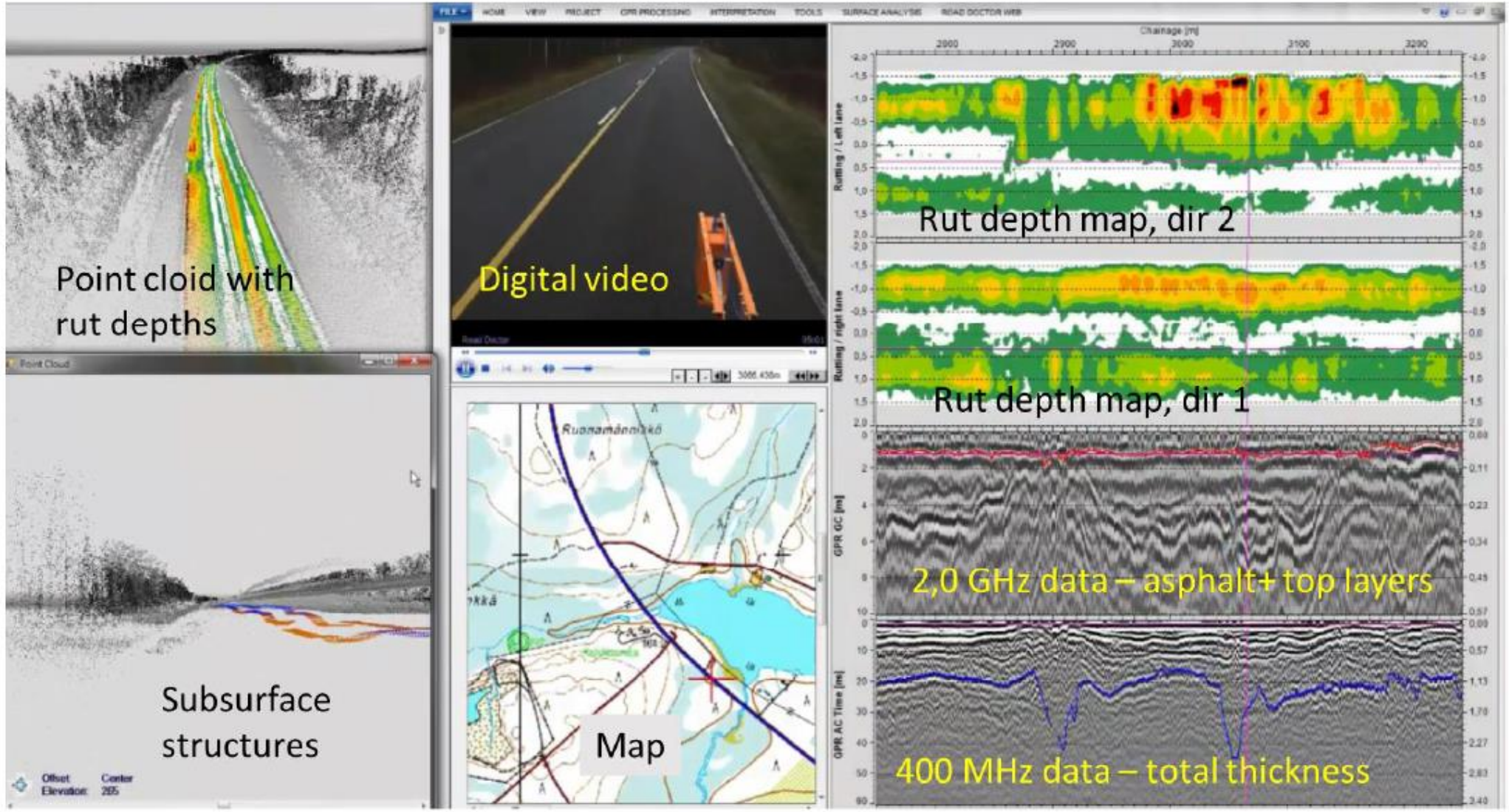


Figure 2. Road Doctor® software view of the road surface and subsurface characteristics.

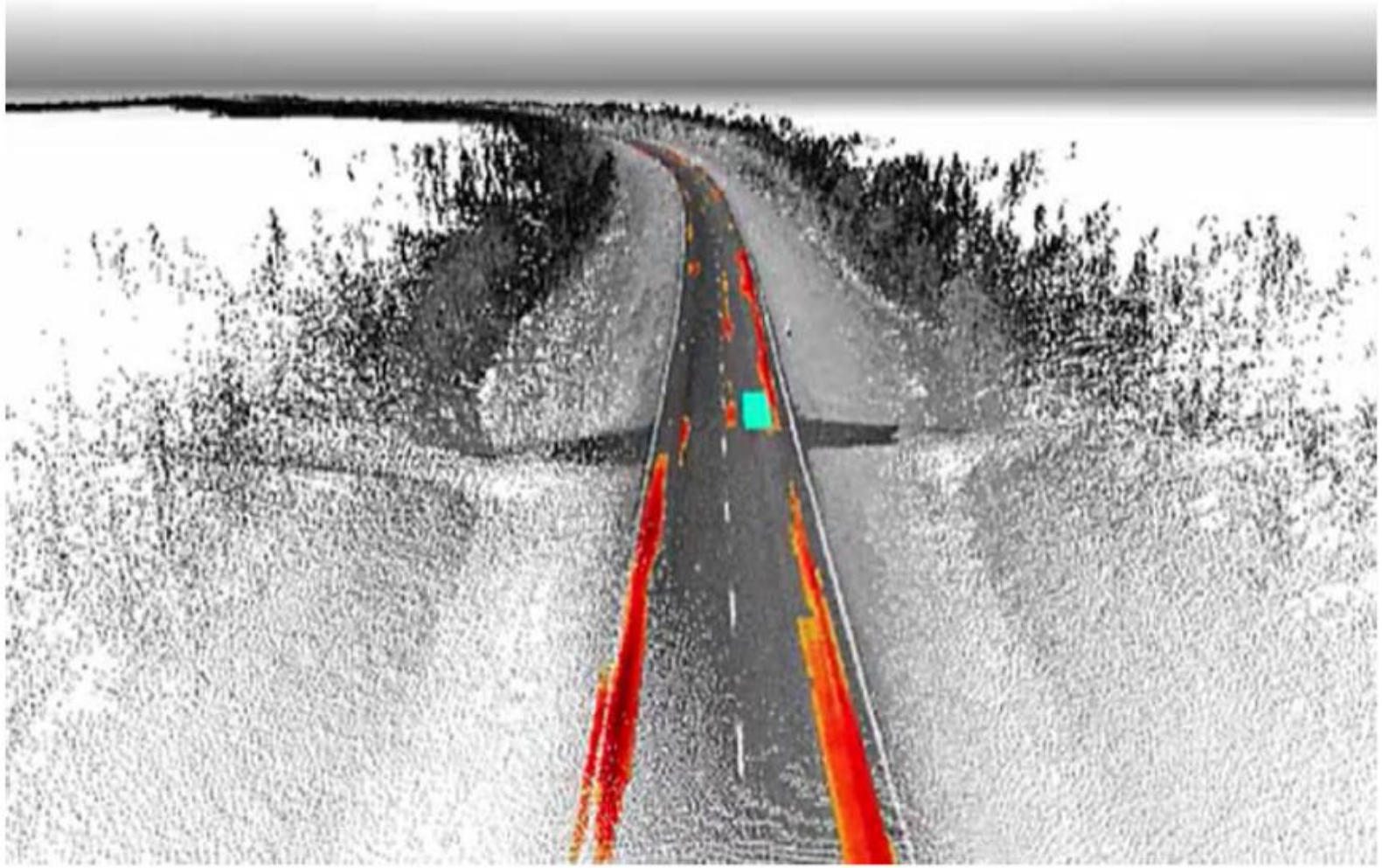


Figure 3. Example of a point cloud video of deformations in pavement surface (red) and locations with roughnes problems (blue). In the future this data could be viewed by a pavement engineer in a moving car but also truck drivers, for instance, could be warned about problem sections using this technique.

The lignin binds the road and increases durability

Increases carrying capacity of the road

More resistant to frost/thaw damage than bitumen because it's more flexible

Binds dust – was originally developed as a dust binder

Well suited also for fine materials, as opposed to bitumen

Sustainable – a byproduct from paper production with an EPD certificate, the lignin binds carbon from the atmosphere in the road, and is completely harmless to nature, animals and humans

Our Advantage

1. **Improved carrying capacity and durability** of the road

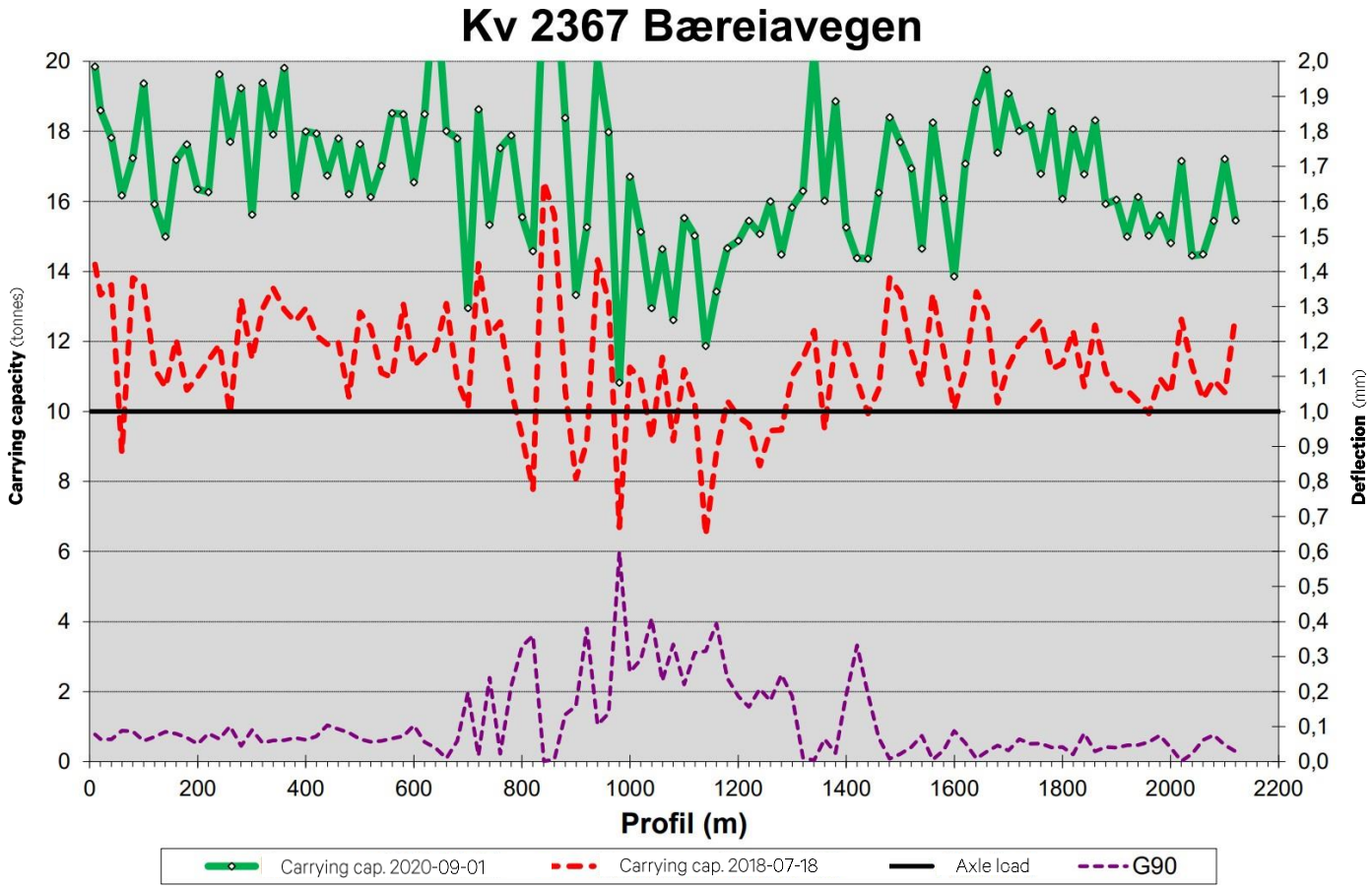
2. **Cost competitive and faster** than traditional method

3. **Negative carbon footprint** – est. 5 tons CO2 per 100m road

1. Carrying capacity increase up to 5 tons

Increases carrying capacity of the road up to 5 tons, as demonstrated here by a recently tested road in Norway

Exact carrying capacity will depend on the type of soil and water content – but all roads will get better



1. The flexibility of lignin make the road less vulnerable to damage

ROAD TESTED WITH DIFFERENT TECHNOLOGIES[1]

Road strenghtened with additional asphalt layer

In the tests of load-bearing capacity done one year after refurbishing the road, this stretch had the highest increase in load bearing capacity. But the stretch sees **clear damage two years later due to thaw damage**

Road stabilized with the Carbon Crusher method

In the tests of load-bearing capacity done one year after refurbishing the road, the Carbon Crusher stretches has the second best increase in load-bearing capacity (after new asphalt, but better than full replacement of soil). However, **two years later Carbon Crusher stretches has no visible damage**

1 One stretch additional asphalt layer, two stretches of full replacement of soil, two stretches with Carbon Crusher method
Sources: Lindås kommune forsterker veier med "trelim" - Norsk Kommunalteknisk Forening (kommunalteknikk.no)

2. Our method recycles the road on the spot, improving logistics, time and costs

Improved logistics

On-the-spot recycling of materials requires less heavy-duty vehicles to supply materials. Size of equipment allows for traffic to pass on one lane

Improved speed

On-the-spot crushing and recycling makes the operation faster than the traditional methods

Improved cost

Our method is on par or slightly cheaper than traditional methods

We stabilize both gravel and asphalt roads

Gravel roads

- **Much harder and more stable** than the original road
- **No dusting** – binder also used for dust control
- **No new gravel or stabilization needed** in 15-20 years
- **Can asphalt the road after** 2-6 week or in a few years if desired

Asphalt roads

- Asphalt mixed in with gravel below **forms a stable base layer** beneath new asphalt
- **Better resist thaw damage** than bitumen stabilization
- **Can asphalt the road after 2-6 week** or in a few years

We have long experience of happy customers – from 15 years of experience

80% + recurring customers

80% of customers in 2018 have used us again – of the ones who haven't, more than half say they would like to but don't have budgets or any specific need

Norwegian Road Authority

has been a driver of our success, using our methods in numerous country roads

Statens vegvesen

~300 roads stabilized

in Norway since we were founded

Larvik kommune

Hafslund Eco

Rogaland fylkeskommune

mesta

LILLEHAMMER KOMMUNE

PRESIS VEGDRIFT

Our customers are municipalities, counties and private players

Municipalities

- 16 municipalities 2018-2021

Ål kommune
- kulturkommunen

Hægebostad Kommune

Stange kommune

ULLENSAKER KOMMUNE

Larvik kommune

Grimstad

LILLEHAMMER KOMMUNE

Counties

- 6 of 11 counties in Norway served[1] 2018-2021
- Norwegian Road Authority has been a key customer using us on county roads

Statens vegvesen

Private players

- Selected private customers with roads as well as larger road construction companies as sub-contractors

STAVEN GRUS

Hafslund Eco

Kattekleiv Barnehager

mesta

PRESIS VEGDRIFT

1 Using latest country organization – some served prior to recent re-organization

What our customers say

Contact details available on request

"We had a **road close to a drinking water source** and wanted to strengthen the road with **minimal risk of pollution**.

We used the road to test different technologies[1] on different sections. **Two years later**, the sections with the **Carbon Crusher method had no damage,** while **sections with additional asphalt layer had large cracks**"

- Lindås Municipality

"**It was the first time we had used the Carbon Crusher method**. There were a lot of discussions about whether we should try this new method or not, but **the price and time spent was way below what competitors could offer**, and they had long experience in doing it. We put asphalt on 1 year later due to budget constraints. The road was hard and very stable - even the asphalt provider said he thought it was the right choice to go with Carbon Crusher, as **the road was 'rock solid and stable'**"

- Smøla Municipality

"**Carbon Crusher is an alternative to full replacement of the road masses**. Have tried other competitors with mixing mills but it's not the same, it doesn't' crush the road well enough. Carbon Crusher can do a lot for a very good price, **it has very good price-quality**"

- Large county using Carbon Crusher multiple times since 2017

1 One stretch additional asphalt layer, two stretches of full replacement of soil, two stretches with Carbon Crusher method

Name of Road / project	Year	Square metres	Surface before	Surface after	Page
Bøenvegen, Notodden	2007	21,021	Asphalt	Asphalt	2
Roheimvegen, Bø	2007	15,200	Dirt road	Dirt road	5
Road 301, Finsland in Agder	2014	4,840	Asphalt	Asphalt	9
Road 306, Finsland in Agder	2014	5,500	Dirt road	Dirt road	12
Kleivdalsveien, Bergen	2015	8,766	Asphalt	Asphalt	15
Austrumsdalsveien , Rogaland	2016	7,263	Asphalt	Asphalt	18
Nedrebøveien , Rogaland	2016	45,358	Asphalt	Asphalt	21
Barstadveien, Hauge i Dalane	2016	26,490	Asphalt	Asphalt	24
Risaveien, Time i Rogaland	2016	15,000	Asphalt	Asphalt	27

Bøenvegen, Gransherad/Notodden (2007)

Key facts

Road address		Bøenvegen, Gransherad/Notodden, Norway	
Road type and traffic profile		Rural municipal road connecting local neighborhoods and Gransheradveien	
Typical weather	**Temperature range:**	-20 to +30 °C	-4 to +86 °F
	Perspiration:	380 mm	14,96 inches
Surface area refurbished		21,021 m2	
Road surface before refurb.		Asphalt road	
Road surface after refurb.		Asphalt road	
Date of refurbishment		July 2007	
Work performed		Full depth reclamation and "crushing" of the road with CC's Crusher, stabilizing with lignin and recompacting performed by Carbon Crusher (then called Crusher International). Asphalted by other contractor.	

Roheimvegen, Bø (2007)

Key facts

Road address		Roheimvegen, located at Reskjemheia between Notodden and Bø in Telemark, Norway.	
Road type and traffic profile		Rural municipal road connecting local neighborhoods and Vatnarveien	
Typical weather	**Temperature range:**	-20 to +30 °C	-4 to +86 °F
	Perspiration:	380 mm	14,96 inches
Surface area refurbished		15,200 m2	
Road surface before refurb.		Gravel road	
Road surface after refurb.		Gravel road	
Date of refurbishment		September 2007	
Work performed		Full depth reclamation and "crushing" of the road with CC's Crusher. Some, but not much additional masses added, before the road was stabilized with lignin and recompacting performed by Carbon Crusher (then called Crusher International). Intention was to add asphalt as top layer but this has not been done.	

Thank You!