

GREENSPEED



Energy efficient driving



**Saves energy = saves our environment  
and the energy budget!**

**In DSB:**

- **11-16% traction energy savings**
- **(35 mill. DKK / 4,7 mill. EUR per Year)**



# Significant improvements



## Energy Savings

The most efficient way of driving is continuously calculated according to the current situation and presented to the driver as a speed recommendation. The driving strategy is customized to the individual operator based on current driving style, types of rolling stock and topography to achieve the highest level of energy savings.



## Reduced Maintenance

By reducing the number of accelerations and brakings as well as keeping the maximum speed as low as possible maintenance costs can be kept to a minimum. GreenSpeed will never recommend a speed higher than necessary and will always calculate the most efficient braking profile while considering variations in the topography.



## Punctuality

GreenSpeed's first priority is to keep within the timetable. If the train is delayed GreenSpeed will guide the driver to run on schedule, of course by energy efficient means. The train will always arrive on time, when possible, with minimal energy consumption.



## Working Environment

Released from doing complicated calculations the driver's workload is reduced and there is no need to be concerned about getting to the station in time. GreenSpeed will always give the best recommendations to run on schedule and adapt to the current situation regardless of outside influences.



## Safety

GreenSpeed handles all information required to do the advanced mathematical calculations necessary to arrive on time, such as position, timetable and speed limitations. This means that the driver can be more focused on safety related aspects.

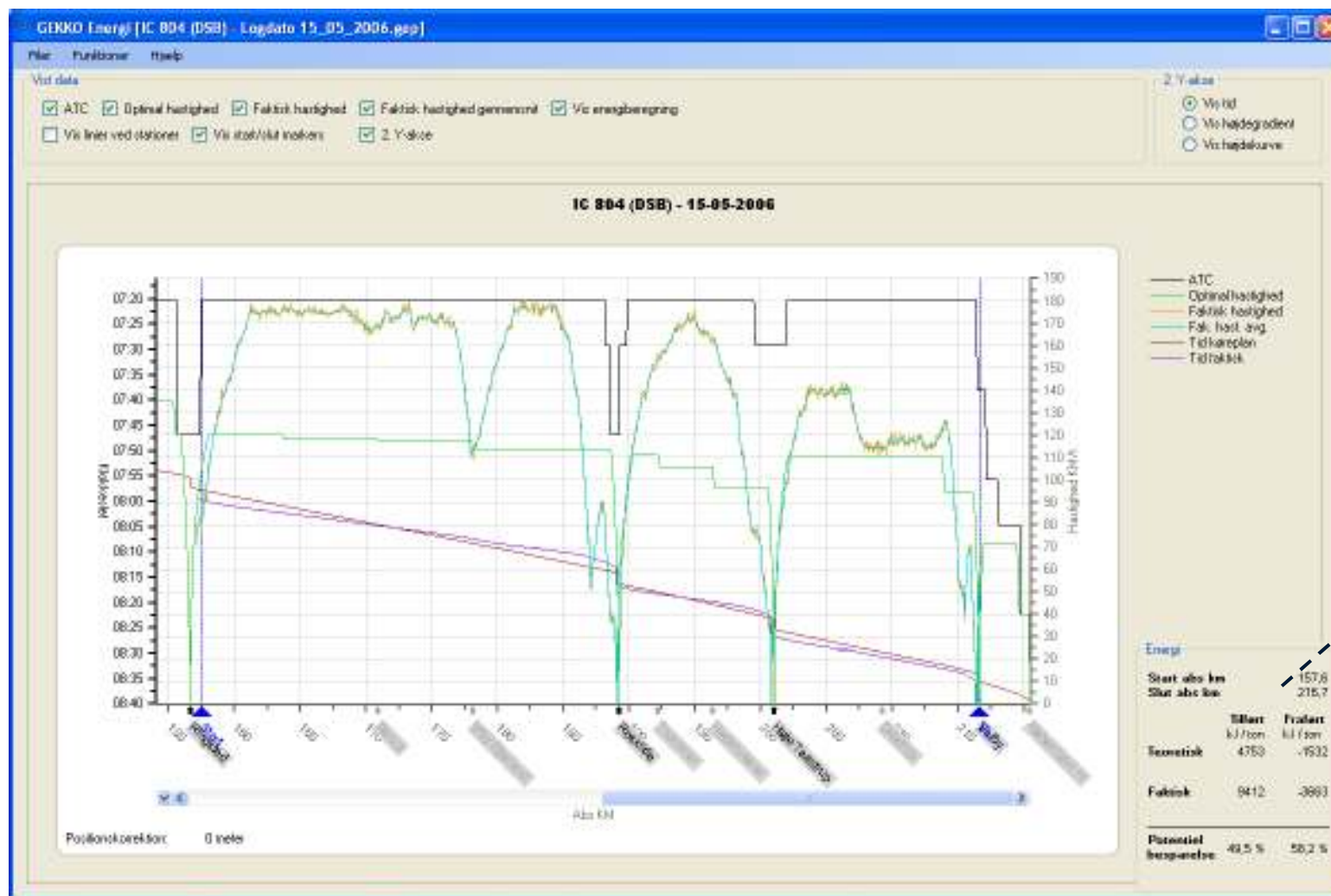


## More Satisfied Customers

GreenSpeed's recommendations will have a noticeable effect on the customers' experience. Not only will the customers see an immediate improvement in punctuality but they will also have a more comfortable trip as they are not exposed to unnecessary vibrations and jerks because of the smooth speed profile.



# Max speed – an **expensive** driving strategy



Energi		
	Tilført kJ / ton	Fraført kJ / ton
Teoretisk	4753	-1532
Faktisk	9412	-3663
<b>Potentiel besparelse</b>	<b>49,5 %</b>	58,2 %

## GreenSpeed in a nutshell

### Foundation:

- Data from land based systems (ex. time tables and speed limits)
- Real time data from the train (ex. speed, position, acceleration ability)

### Real time calculations

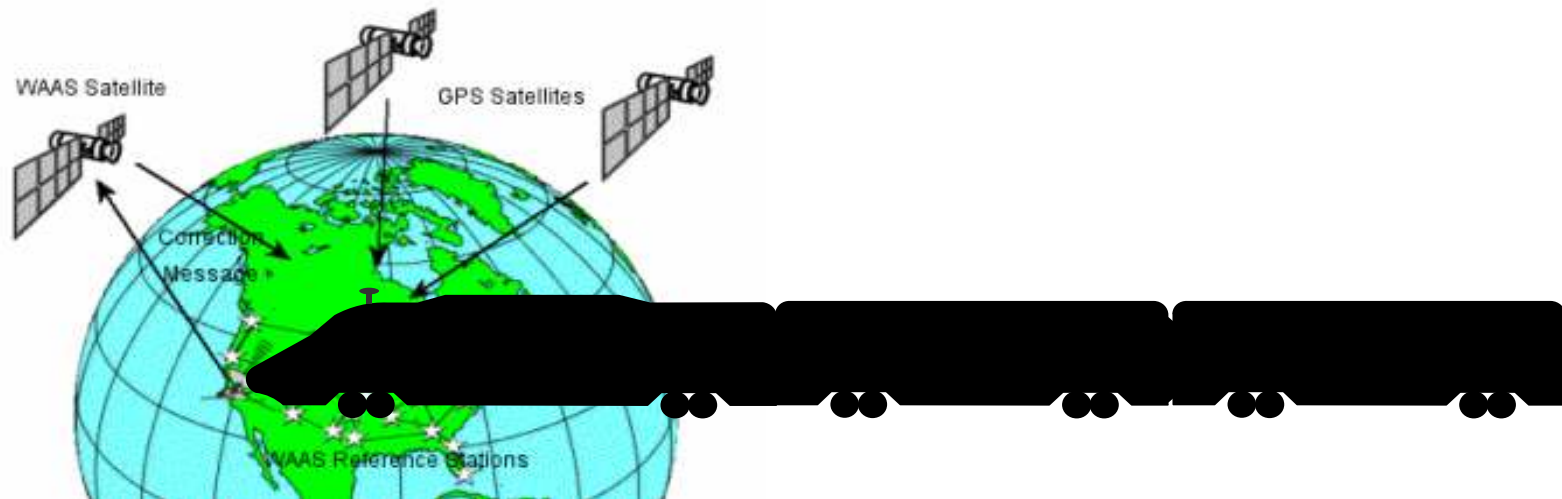
- Advanced algorithm for calculating the optimal speed profile

### Simple graphical user interface

- Only current and relevant data is displayed

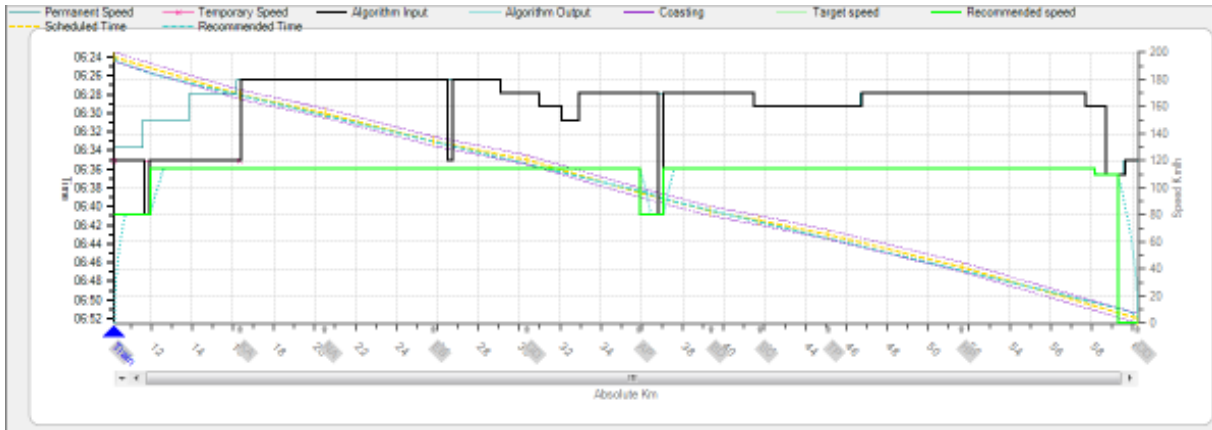
### No more papers

- The screen displays all and only relevant data in all given situations

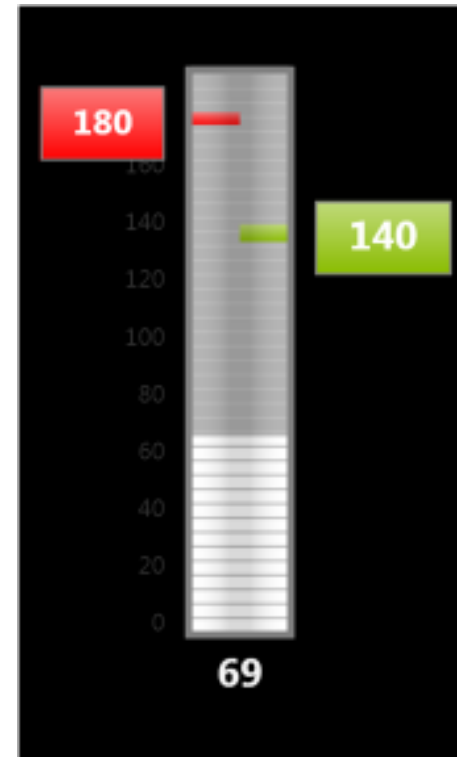
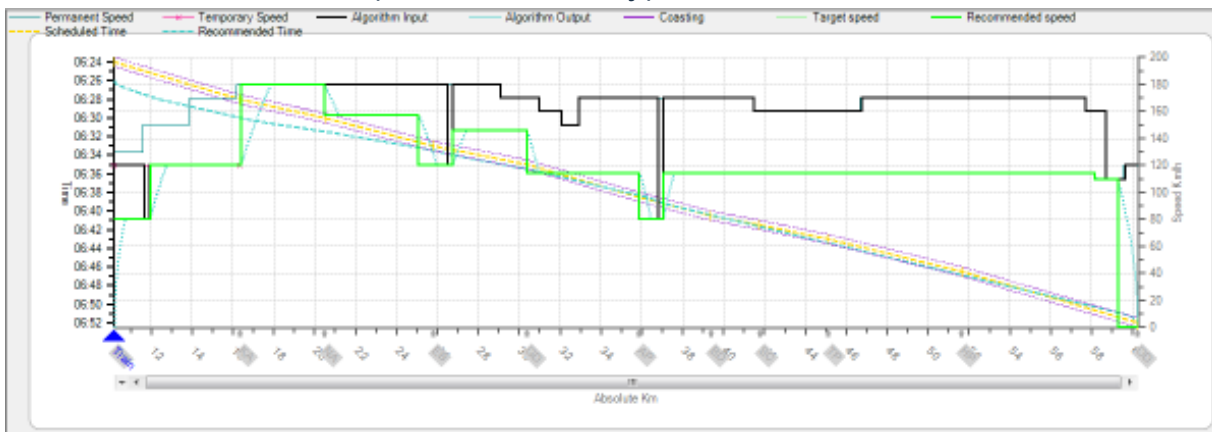


# Continuous calculations

Middelfart->Odense (planned departure)



Middelfart->Odense (2 minutes delay)



# Drivers Screen (DMI)

Speed Area

Operations Area

Information Area

Menu

**18:03:39** 2. nov

180

140

69

**180**

A-kanal	D-kanal	C-kanal	Spor	Km	Strækning
64	49	22	<b>H</b>	4,305	1

**Høje Taastrup**

Spor: 3 Ankomst: 18:11:00 Rettidighed

**3 18:11:00 Rettidig**

Spor: 3 hsp  
Ankomst: 18:11:00

**120** 2001  
27,2 - 27,9 00:00 - 24:00

Spor 3.hsp  
Banens tilstand

**Hedehusene**  
Km: 24,176  
Spor: 3 hsp  
Ankomst: 18:13:00

**Høje Taastrup**  
Km: 19,500  
Spor: 3  
Ankomst: 18:11:00

**Glostrup**  
Km: 11,214  
Spor: 2  
Ankomst: 18:07:00

**Hvidovre Fjern**  
Km: 7,300  
Spor: 2  
Ankomst: 18:05:00

Menu

+

Lysstyrke

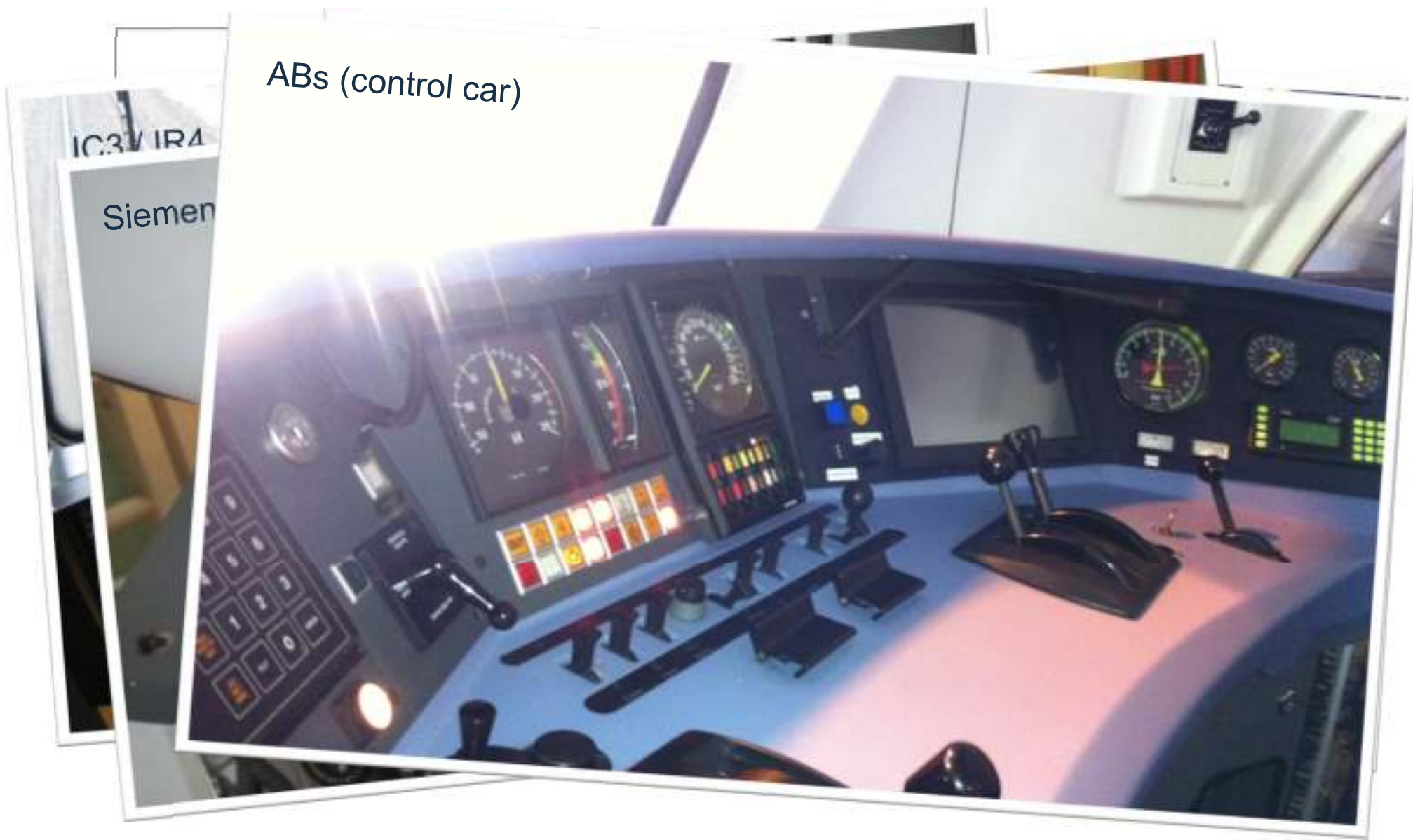
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# Train types with GreenSpeed in DSB

ABs (control car)



# GreenSpeed is Well-Informed

For GreenSpeed to be able to give recommendations it needs a set of essential data in addition to knowledge about the current position.

The data can either come from already established data sources within the infrastructure company or from the operator.

If data is not available, there are solutions to manually supply the system with required data.

Tools are also available to collect infrastructure data like track locations and speed limits as well as practical train characteristics.

## Infrastructure



- Track locations
- Altitudes
- Stations

## Timetable



- All stations and passagepoints
- Arrival/Departure
- Expected track

## Speed Limits



- Permanent limits
- Temporary limits

## Position



- GPS receiver
- Tachometer
- ERTMS

## Track usage



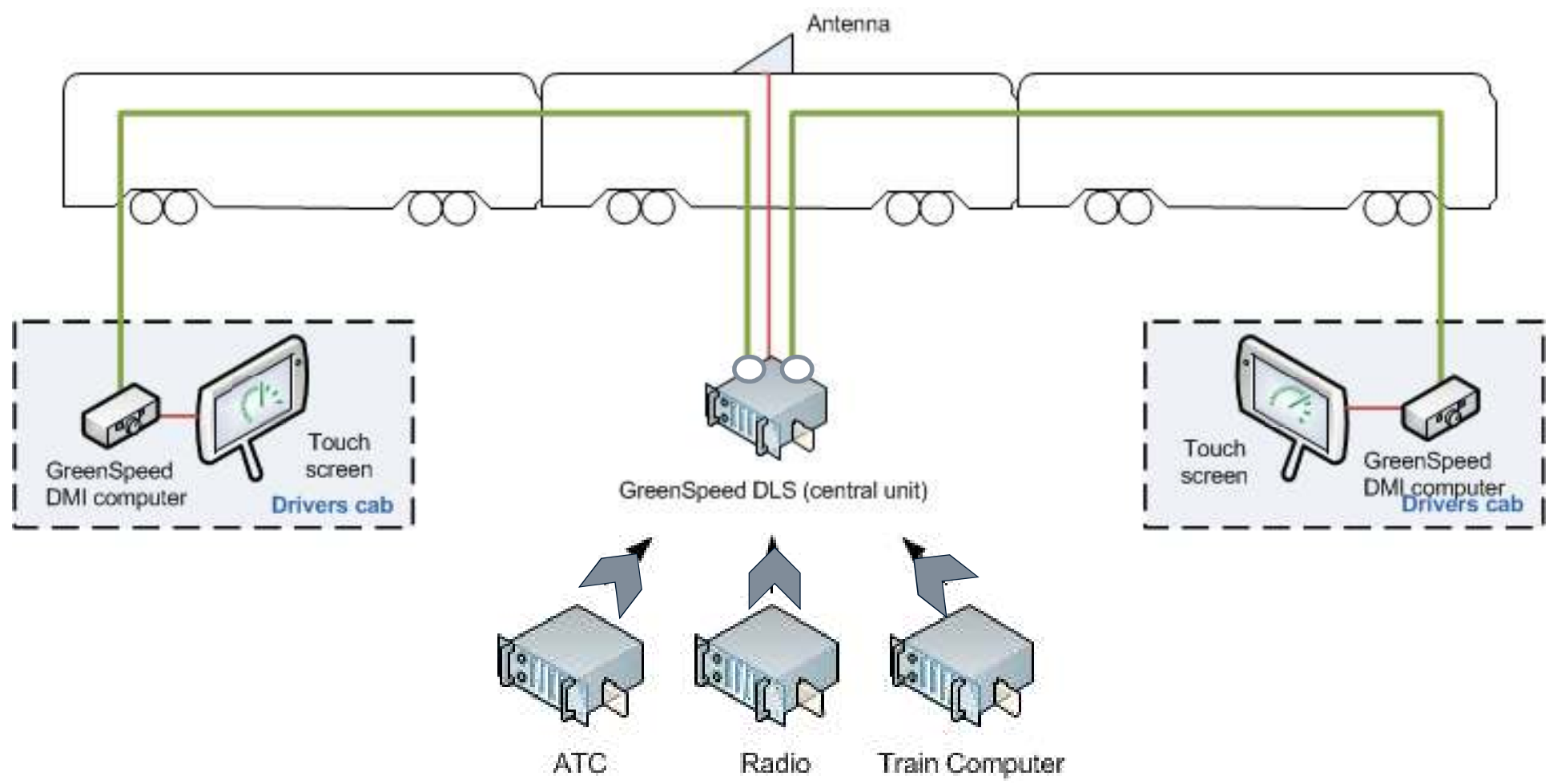
- Updated track usage
- Transmitted real-time

## Train Characteristics



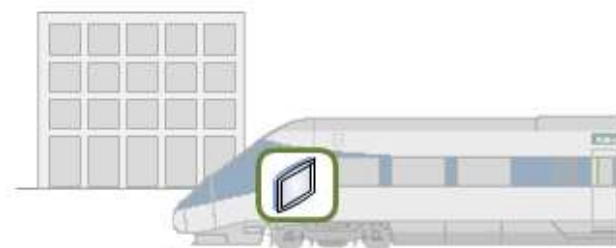
- Length and weight
- Maximum speed
- Resistances
- Acceleration/braking

# GreenSpeed hardware onboard the train (level 3)



# Levels

## LEVEL 1



### Portable

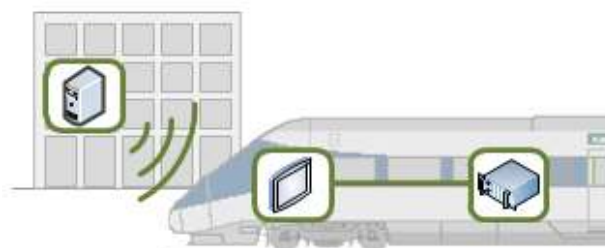
Dette er den mest simple udgave af systemet. Denne udgave kræver ingen installation af hardware på toget.

Versionen er primært beregnet til test af systemet.

- Simple udgave til test
- Kræver ingen installation
- Begrænset datagrundlag



## LEVEL 2



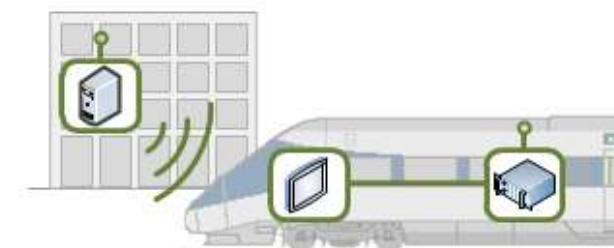
### Dynamic

Denne udgave tilbyder en dynamisk og fleksibel løsning med altid opdateret data til og fra land.

Løsningen kræver ikke integrationer med eksisterende systemer, da informationerne indtastes manuelt centralt på landsiden.

- Opdaterede køreplaner fra land
- Ingen krævende integrationer med eksisterende systemer
- Solid platform på toget
- Flådestatus
- Mulighed for data fra toget

## LEVEL 3



### Intelligent

Denne udgave bygger på den dynamiske udgave, men indeholder yderligere integrationer med eksisterende systemer både på tog og land.

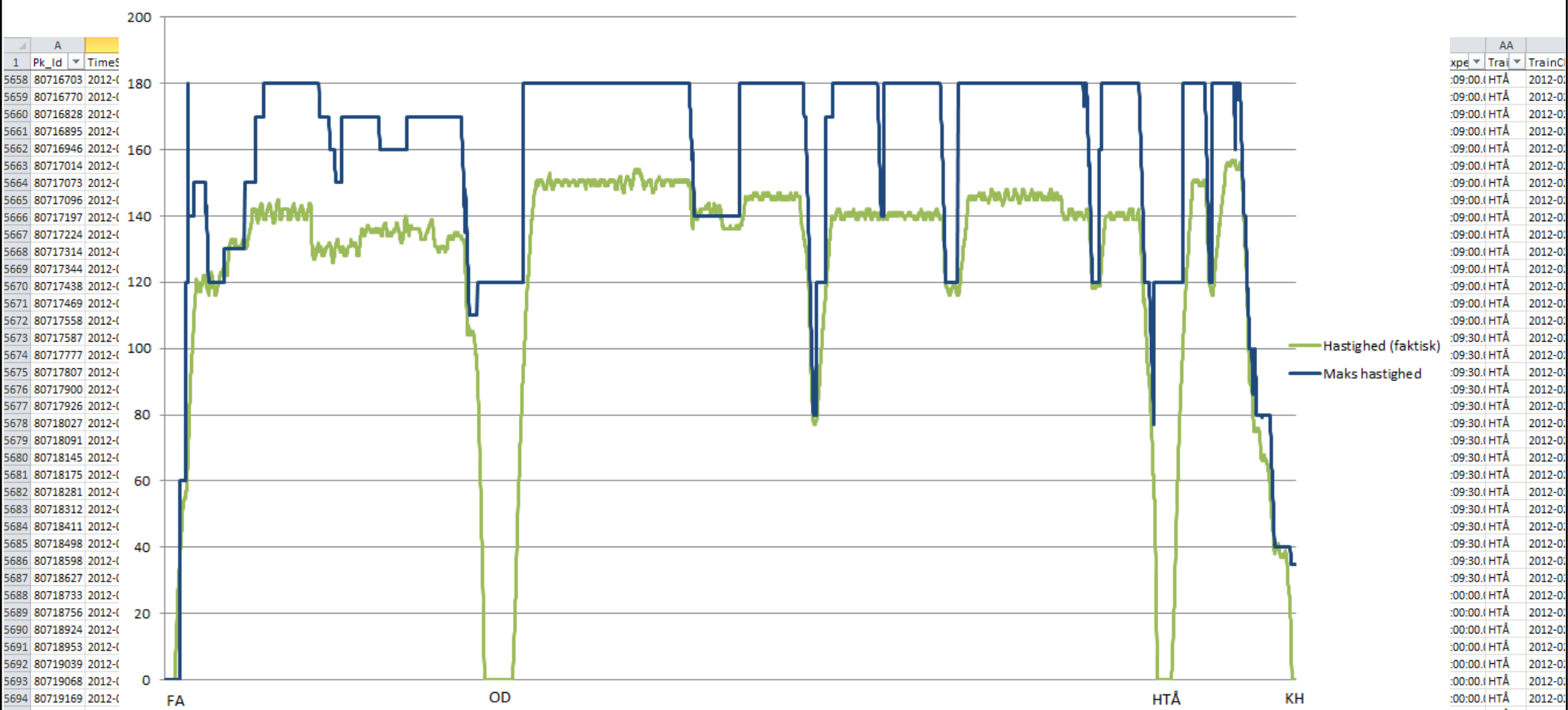
Tilbyder den størst mulige optimering af kørsel og dermed energibesparelse.

- Fulldautomatisk datagrundlag
- Bedst mulige datagrundlag gennem integrationer på både tog og land
- Størst mulig optimering af kørsel / energibesparelse





# Detailed status every second

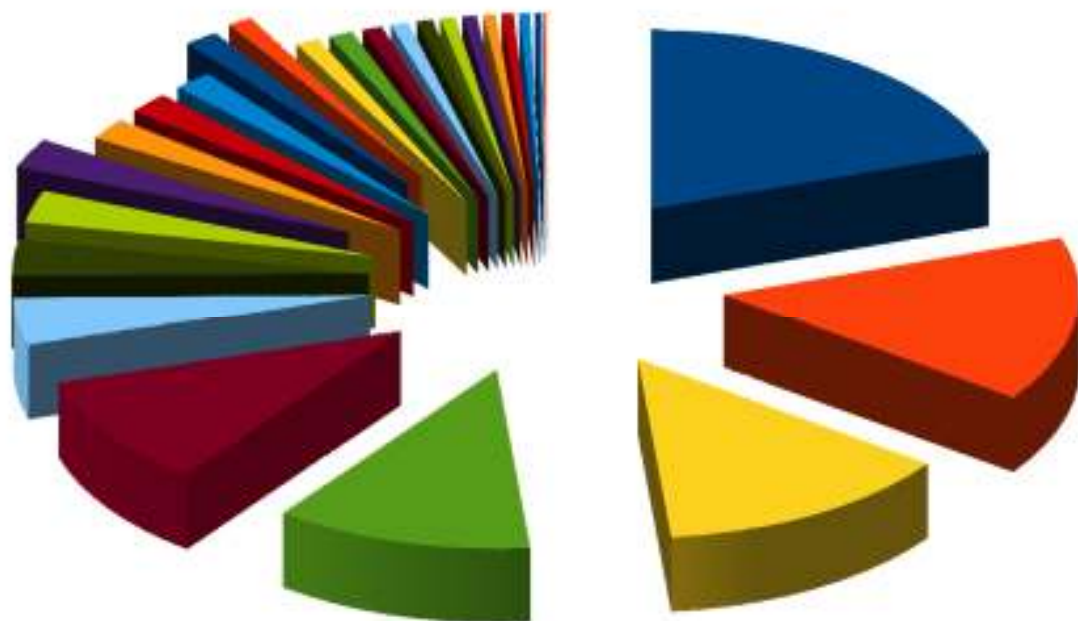


1	A	Time	AA	TrainC
5658	80716703	2012-02-06 11:09:18.445	HTÅ	2012-02-06 11:09:18.445
5659	80716770	2012-02-06 11:09:19.450	HTÅ	2012-02-06 11:09:19.450
5660	80716828	2012-02-06 11:09:20.457	HTÅ	2012-02-06 11:09:20.457
5661	80716895	2012-02-06 11:09:21.464	HTÅ	2012-02-06 11:09:21.464
5662	80716946	2012-02-06 11:09:22.471	HTÅ	2012-02-06 11:09:22.471
5663	80717014	2012-02-06 11:09:23.478	HTÅ	2012-02-06 11:09:23.478
5664	80717073	2012-02-06 11:09:24.485	HTÅ	2012-02-06 11:09:24.485
5665	80717096	2012-02-06 11:09:25.492	HTÅ	2012-02-06 11:09:25.492
5666	80717197	2012-02-06 11:09:26.499	HTÅ	2012-02-06 11:09:26.499
5667	80717224	2012-02-06 11:09:27.506	HTÅ	2012-02-06 11:09:27.506
5668	80717314	2012-02-06 11:09:28.513	HTÅ	2012-02-06 11:09:28.513
5669	80717344	2012-02-06 11:09:29.520	HTÅ	2012-02-06 11:09:29.520
5670	80717438	2012-02-06 11:09:30.527	HTÅ	2012-02-06 11:09:30.527
5671	80717469	2012-02-06 11:09:31.534	HTÅ	2012-02-06 11:09:31.534
5672	80717558	2012-02-06 11:09:32.541	HTÅ	2012-02-06 11:09:32.541
5673	80717587	2012-02-06 11:09:33.548	HTÅ	2012-02-06 11:09:33.548
5674	80717777	2012-02-06 11:09:34.555	HTÅ	2012-02-06 11:09:34.555
5675	80717807	2012-02-06 11:09:35.562	HTÅ	2012-02-06 11:09:35.562
5676	80717900	2012-02-06 11:09:36.569	HTÅ	2012-02-06 11:09:36.569
5677	80717926	2012-02-06 11:09:37.576	HTÅ	2012-02-06 11:09:37.576
5678	80718027	2012-02-06 11:09:38.583	HTÅ	2012-02-06 11:09:38.583
5679	80718091	2012-02-06 11:09:39.590	HTÅ	2012-02-06 11:09:39.590
5680	80718145	2012-02-06 11:09:40.597	HTÅ	2012-02-06 11:09:40.597
5681	80718175	2012-02-06 11:09:41.604	HTÅ	2012-02-06 11:09:41.604
5682	80718281	2012-02-06 11:09:42.611	HTÅ	2012-02-06 11:09:42.611
5683	80718312	2012-02-06 11:09:43.618	HTÅ	2012-02-06 11:09:43.618
5684	80718411	2012-02-06 11:09:44.625	HTÅ	2012-02-06 11:09:44.625
5685	80718498	2012-02-06 11:09:45.632	HTÅ	2012-02-06 11:09:45.632
5686	80718598	2012-02-06 11:09:46.639	HTÅ	2012-02-06 11:09:46.639
5687	80718627	2012-02-06 11:09:47.646	HTÅ	2012-02-06 11:09:47.646
5688	80718733	2012-02-06 11:09:48.653	HTÅ	2012-02-06 11:09:48.653
5689	80718756	2012-02-06 11:09:49.660	HTÅ	2012-02-06 11:09:49.660
5690	80718924	2012-02-06 11:09:50.667	HTÅ	2012-02-06 11:09:50.667
5691	80718953	2012-02-06 11:09:51.674	HTÅ	2012-02-06 11:09:51.674
5692	80719039	2012-02-06 11:09:52.681	HTÅ	2012-02-06 11:09:52.681
5693	80719068	2012-02-06 11:09:53.688	HTÅ	2012-02-06 11:09:53.688
5694	80719169	2012-02-06 11:09:54.695	HTÅ	2012-02-06 11:09:54.695
5695	80719202	2012-02-06 11:09:55.702	HTÅ	2012-02-06 11:09:55.702
5696	80719304	2012-02-06 11:09:56.709	HTÅ	2012-02-06 11:09:56.709
5697	80719386	2012-02-06 11:09:57.716	HTÅ	2012-02-06 11:09:57.716

PK_Id	Time	AA	TrainC
80719202	2012-02-06 11:09:55.702	HTÅ	2012-02-06 11:09:55.702
80719304	2012-02-06 11:09:56.709	HTÅ	2012-02-06 11:09:56.709
80719386	2012-02-06 11:09:57.716	HTÅ	2012-02-06 11:09:57.716

# Savings potential (mill. EUR pr. year)

Based on Panorama of transport 2009



- DE 82    ■ UK 63    ■ FR 56
- ES 48    ■ IT 42    ■ PL 18
- AT 14    ■ CZ 12    ■ SE 11
- RO 8    ■ BE 8    ■ NL 7
- NO 6    ■ DK 4,7    ■ HU 4,6
- FI 4,5    ■ LV 3,7    ■ LT 3,4
- PT 3    ■ BG 2,8    ■ EL 2,7
- EE 2,3    ■ IE 2,2    ■ SK 2
- SI 1,3    ■ LU 0,4

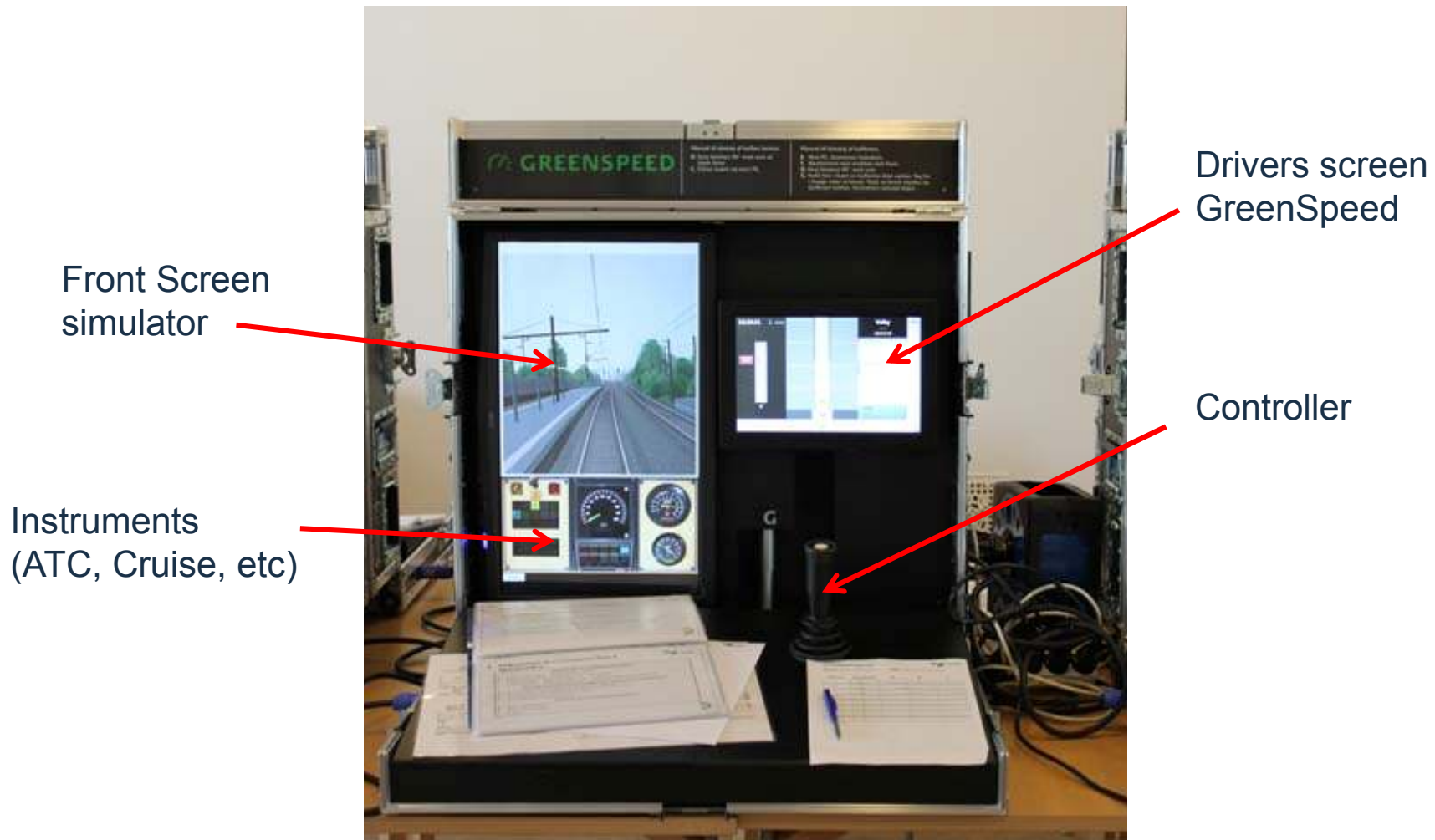




## Classroom training



# Training device demonstration





**Thank you for listening**