Amsterdam, June 9th

booz&co.

Examination of NS forecasts of an additional Hoogeveen IC stop

This report was commissioned by, and prepared for, Ministerie van Verkeer en Waterstaat by Booz & Company. The findings and conclusions set forth in the report represent our best professional judgment based on information made available to it by the Ministry, NS and others. We have relied on, and not independently verified, data provided to it by such sources and on secondary sources of information cited in the report. We note that if the information provided to us by such sources or obtained from secondary sources proves to be incorrect, the conclusions stated in our report could also be incorrect.

Booz & Company have undertaken an examination of the NS models that forecast the impact of an additional IC stop Hgv

Current service

Groningen - Zwolle corridor

Train	Stops	Departure
1x Intercity	Groningen – Assen– Zwolle – Den Haag	.44
1x Intercity	Groningen – stopping – Zwolle – Schiphol	.04
1x Sprinter	Groningen – Zwolle	.25

NS 2010 plan

Train	Stops	Departure
2x Intercity	Groningen – Assen – Zwolle Den Haag (1x) - Schiphol (1x)	.46/.16
2x Sprinter	Groningen – Zwolle	.02/.32

Consequence

- Meppel[1)], Hoogeveen, Beilen and Haren will not be served by IC's in the new timetable

Comments

- NS have proposed a new 2010 timetable which will increase the frequency between Zwolle and Groningen
  - Frequency will be increased from 3 to 4 trains per hour
  - The changes in timetable will only have effect on weekdays
- As a consequence, the fast Intercity will omit Meppel, Hoogeveen, Beilen and Haren
- These stations will not be served by IC's in the new timetables which will have consequences for the transits of passengers travelling longer distances
  - Current IC passengers who travel to the Randstad from these stations will now have to transfer in Zwolle
  - Current Sprinter passengers who travel to Utrecht and further have to transfer in Zwolle instead of Amersfoort
- The Dutch parliament has asked for an examination of the NS forecasts for an additional Hoogeveen IC stop

1) Meppel will be served by IC's to and from Leeuwarden

Source: NS

We have been asked to answer three questions and undertake sensitivity analysis with alternative assumptions from Hoogeveen

Questions

1. Can Booz & Company confirm that NS have used their model 'Pact van Haubrich' to forecast the effects of the new proposed 2010 timetable on the Zwolle- Groningen corridor (without Hoogeveen as IC stop)?
2. Can Booz & Company confirm that NS have used the same model to forecast the effects of an additional IC stop at Hoogeveen
3. Can Booz & Company confirm that the two models use an internally consistent methodology and assumptions and provide consistent outputs?

Sensitivity analysis

4. Examine Hoogeveen growth forecasts based on the documentation provided by the Ministry (letter of the municipality of Hoogeveen send to NS, dated 12 February 2009) and undertake a sensitivity test of NS's model to changes in growth forecasts
5. Undertake sensitivity test of NS's model on alternative dwelling times at Hoogeveen

Source: Terms of Reference Ministerie van Verkeer en Waterstaat
Note: Booz & Company have not been asked to assess the models and the correctness of the input data

NS models use an internally consistent methodology and assumptions and provide consistent outputs - once the input data has been corrected

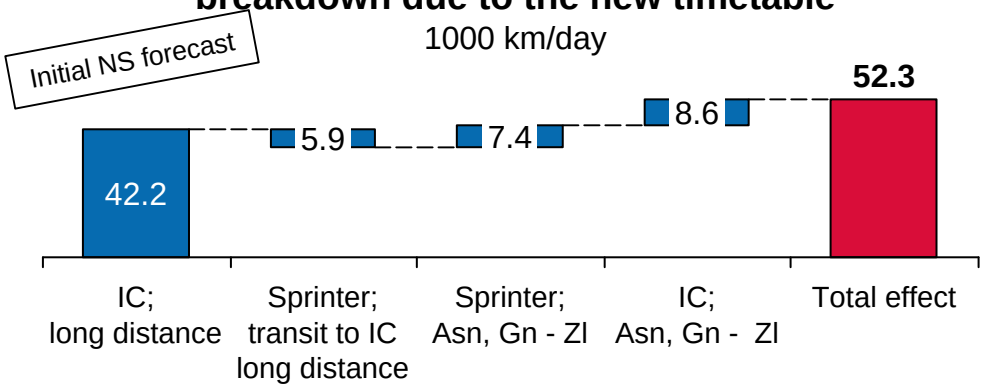
- NS have used the model 'Pact van Haubrich' to forecast additional passenger kilometers for the new 2010 timetable (Zwolle - Groningen corridor)
  - NS models indicate 52,000 additional passenger kilometers per day will be gained
  - As communicated to the parliament, this results in between 13 and 15 million additional passenger kilometers per year
- NS have used the same model to forecast the impact if the inclusion of Hoogeveen in the new timetable as IC stop - this results in a reduction of 25,000 passenger kilometers per day
- These forecasts were made at different time points and were not consistent in terms of input data
  - Both calculations used the most up to date and therefore different base data
  - Effects were calculated on passenger groups, but these groups consisted of different passengers in each scenario
- NS reran their forecasts using consistent base data and the same passengers groups on our request - this shows similar results for the timetable effect and similar kilometers lost for the Hoogeveen IC stop compared to the initial forecasts
- Therefore - even though NS's initial forecasts for the two scenarios were not based upon consistent input data - we can conclude that the forecasts use an internally consistent methodology and assumptions and provide consistent outputs - once the input data has been corrected

Sensitivity analysis of NS's models for alternative assumptions from Hoogeveen still indicate passengers kilometers are lost

- NS models indicate 23,000 - 25,000 passenger kilometers are lost when Hoogeveen is added as IC stop compared to the new timetable without Hoogeveen as IC stop
- We undertook sensitivity analyses using alternative assumptions on Hoogeveen growth and dwelling time at the Hoogeveen station
  - Hoogeveen claims to grow demand by 50% in 1 or 2 years due to local investments in station quality and additional P + R places
  - According to Hoogeveen, 1.5 minutes dwelling time would be achievable for an IC stop at Hoogeveen station
- NS's models indicate between 18,000 and 19,000 passenger kilometers per day are lost when Hoogeveen demand grows 50% in 1 or 2 years
  - However, we have not assessed why Hoogeveen would grow by 50% and other neighboring stations would not
  - We did add a 10% growth scenario for comparison which shows a reduction of 22,000 - 24,000 passenger kilometers per day
- NS's models are sensitive to changes in dwelling time at Hoogeveen but even for 1.5 min the model indicates 9,000 - 10,000 passenger kilometers are lost
- Both sensitivity analyses combined indicate that in the most optimistic scenario (1.5 min dwelling time and 50% growth) for Hoogeveen between 3,000 and 4,000 passenger kilometers per day are lost when Hoogeveen is added as IC stop
- Therefore we conclude that NS's models fed with the Hoogeveen assumptions on dwelling time and demand growth still indicate passenger kilometer losses

NS have used a model to forecast over 50,000 additional passenger kms for the proposed 2010 timetable (Zwolle - Groningen)

Forecasted additional passenger kilometer breakdown due to the new timetable



Passenger groups used for this forecast

Group	Comments
IC long distance	Current stopping IC becomes faster, 2 IC's will leave every 30 min
Sprinter, transit to IC long distance	Passengers from the stopping stations have to transfer in Zwolle when travelling to Randstad
Sprinter, Asn, Gn - Zl	2 sprinters leave every 30 min. and shorter travel time because of faster rolling stock
IC Asn, Gn - Zl	IC's leave every 30 min, are faster and there are more trains (incl. sprinters)

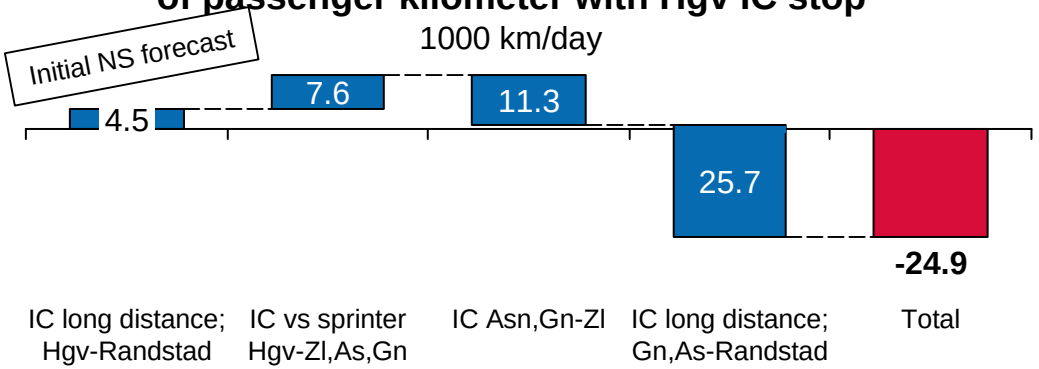
Note: Booz & Company have not audited this model or the input data used
Source: NS

Comments

- NS separated passengers in four main groups that are affected by the new timetable
- NS calculated the impacts for each group in terms of trips, passenger kilometers and revenues in their model 'Pact van Haubrich'
- The NS models indicate that the new proposed timetable for the Groningen - Zwolle corridor will result in over 50,000 additional passenger kilometers per day
  - On a yearly basis this is estimated to amount between 13 and 15 million kilometers

NS used the same model to forecast a decrease in passenger kilometers when Hoogeveen is included as IC stop

Breakdown of forecasted reduction of passenger kilometer with Hgv IC stop



Passenger groups used for this forecast

Group	Comments
IC long distance; Hgv - Randstad	Higher frequency + no transit for passengers between Hoogeveen and Randstad
IC vs sprinter; Hgv - Zl, As, Gn	Higher frequency for passengers between Hoogeveen and IC stops on the corridor
IC Asn, Gn - Zl	Longer travel times for passengers between Groningen and other IC stops
IC long distance; Gn, As - Randstad	Longer travel times for passengers between Groningen, Assen and the Randstad

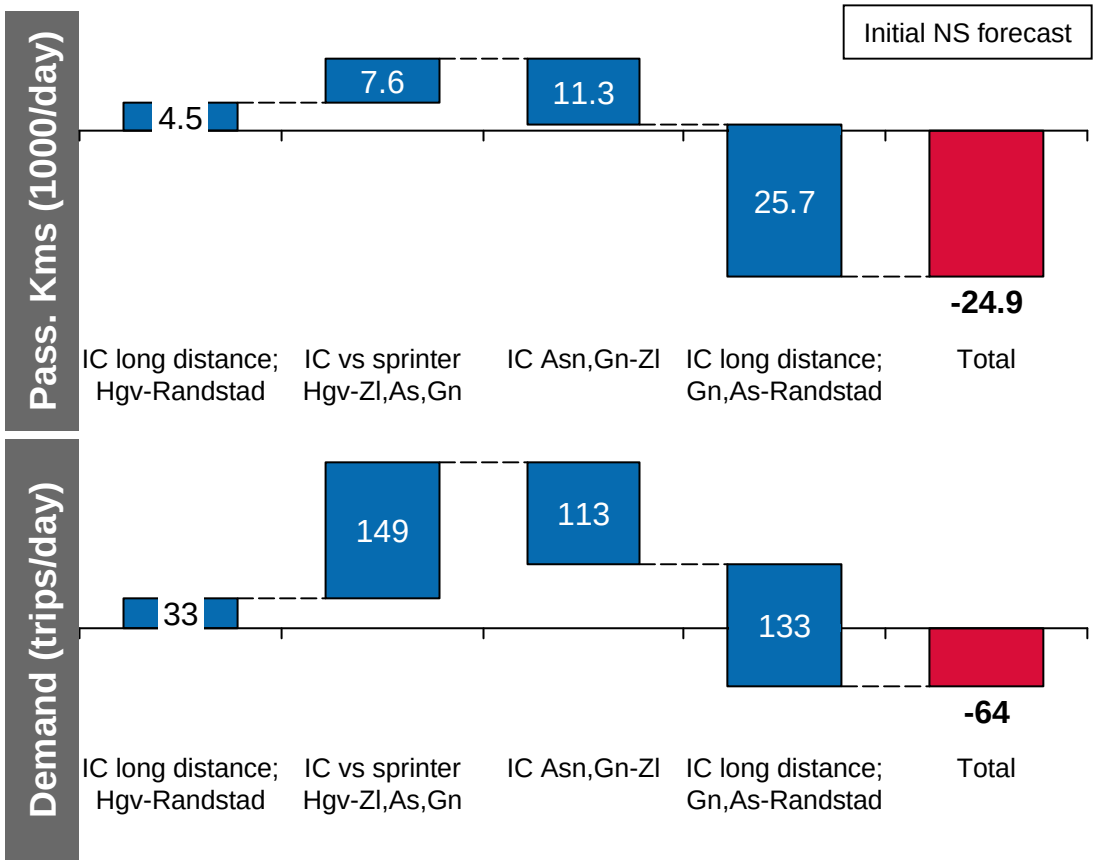
Comments

- NS separated passengers in four groups that are affected by an additional IC stop
- NS calculated the impacts for each group in terms of trips, passenger kilometers and revenues in their model 'Pact van Haubrich'
- The NS models indicate that the additional Hoogeveen IC stop will result in 25,000 passenger kilometers per day lost
  - On a yearly basis this is estimated to amount around 6.5 million kilometers

Note: Booz & Company have not audited this model or the input data used
Source: NS

The additional passenger kilometers won at Hgv do not outweigh losses elsewhere, overall resulting in revenue losses

NS forecasts of the effects of Hoogeveen IC stop



Comments

- The additional stop at Hoogeveen will result in an increase in demand and more trips from/to Hoogeveen
- However, most trips generated at Hoogeveen are on the short routes to Zwolle, Assen or Groningen which generate relatively little passenger kilometers
- The small decrease in demand on the longer routes from Groningen or Assen to the Randstad results in relatively more passenger kilometers lost because these trips are longer
- As revenues are based on passenger kilometers, the addition of Hoogeveen as IC stop results in a decrease in revenues

Source: NS

NS's initial forecasts did not use the same input data but NS redid their forecasts using consistent input

The initial forecast were not made consistently - but for good reasons…

- NS presented their forecast for the new 2010 timetable for the Groningen - Zwolle corridor in September 2008 using the most recent and appropriate data for this forecast
  - NS used 2006 origin-destination matrix data
  - The volumes were grouped in four crude passenger groups that would be affected by the changes
- On request of the Ministry, NS made a forecast for the effects of including Hoogeveen as a IC stop in March 2009 using the most recent data available
  - NS used 2007 allocation data from TRANS systems
  - The volumes were grouped in four different passenger groups that would be affected by the additional stops
- We have asked NS to redo their analyses using consistent input data
  - Both analyses should use the same base data (year and source)
  - And passenger groups should comprise the same passengers, or lines should be treated individually

…and after NS made some changes we can confirm that the models are consistent

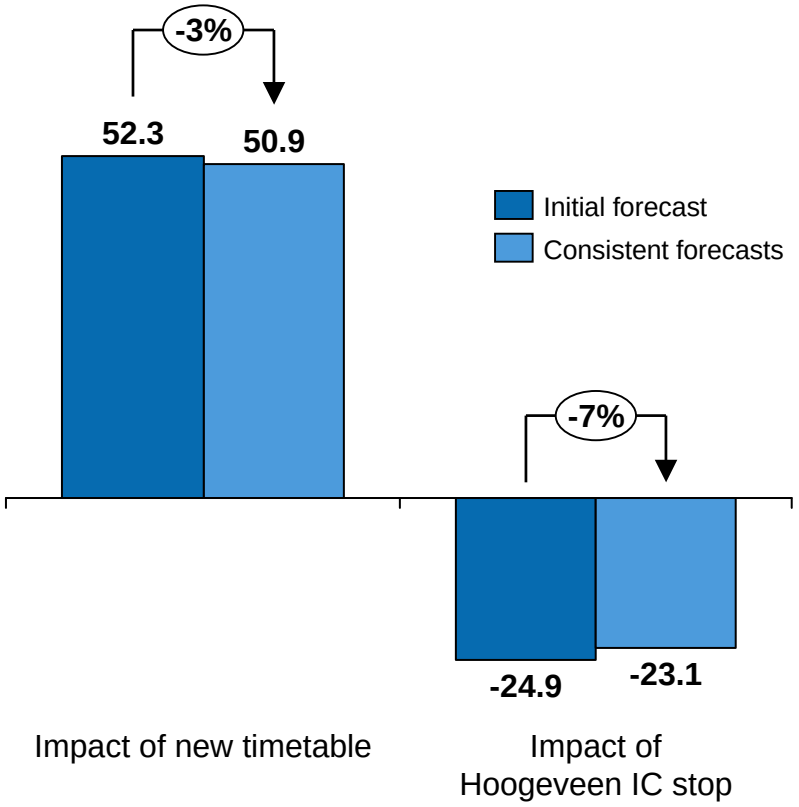
- We conclude that the methodology and input data are consistently applied for both the forecast of the effect of the new timetable and the effect of an additional IC stop at Hoogeveen
  - Elasticities are applied consistently in both forecasts
  - Assumptions on the Generalized Journey Time are consistent between the models and GJT is calculated consistently
  - Base volumes are from the same year and source
  - Effects of both changes are calculated on the same group of passengers

Note: Booz & Company have not assessed the correctness of the input data nor the correctness of all the model assumptions

The consistent model shows similar results for the timetable effect and similar kms lost for the Hgv stop compared to initial forecasts

Comparison of the initial forecasts with the forecasts using the consistent input

Passengers kilometers, x1000/dag



Comments

- The initial forecasted passenger kilometers for the effects of the new proposed 2010 timetable and the additional Hoogeveen IC stop are compared with the new forecasts based on consistent input data
- There are several differences between the models:
  - The consistent forecasts are based on the same base year (2007) whereas in the initial forecasts 2006 and 2007 were used for the different forecasts
  - The consistent forecasts are based on the same source of the base volumes whereas in the initial forecasts TRANS and OD matrix data were used for the different forecasts
  - In the consistent forecasts are calculated for individual lines whereas the initial models used different passenger groups
- The consistent models forecast a 7% lower reduction in passenger kilometers than NS's initial model, but still results in passenger kilometers lost

Source: NS, Booz & Company analysis

Higher growth assumptions for Hoogeveen still result in passenger kilometers lost with similar impacts in both forecasts

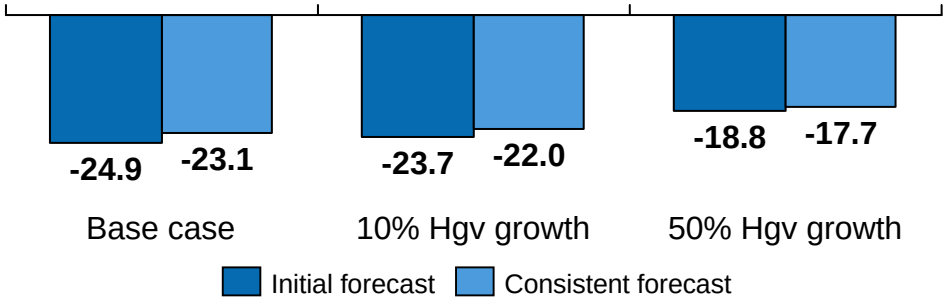
Impacts of Hvg IC stop with 50% Hgv growth

Initial NS forecast

Passenger group	Base volume	50% Hgv growth	Additional trips	Additional pass. kms
Hgv - Randstad	575	862	50	6,754
Hgv - Zl, As, Gn	2,446	3,669	224	11,435
Gn - As, Zl	5,176	5,176	-113	-11,315
Gn, As - Randstad	9,757	9,757	-133	-25,707
		TOTAL	**+ 28**	**- 18,832**

Sensitivity analyses on NS's initial and consistent forecasts

Impacts of Hgv IC stop in base case, 10% and 50% Hgv growth, Pass. kms x1000/day



Hoogeveen growth assumptions

- We undertook sensitivity analyses on Hoogeveen growth assumptions in NS's models
- Hoogeveen claims to grow demand by 50% in 1 or 2 years
- The municipality plans to add 200 P+R spaces and improve the station quality
- A 50% growth scenario shows growth in the number of trips, but a decrease in passenger kilometers of 19,000 per day
- We have also added a 10% growth scenario for Hoogeveen for comparison which shows 24,000 passenger kilometers lost
  - Assuming the additional 200 P+R places would be filled by new passengers, this would give 10% growth in demand
  - However, consultants experience is that at the most 30% of the parking will be used by new users, resulting in a 3% increase in rail demand
  - Extensive station improvements are seen as generating 2-5 % additional demand in the consultants experience
- The sensitivity analyses on NS's initial forecasts are broadly in line with the forecasts using consistent input

Note: Booz & Company have not assessed the plausibility of Hoogeveen's growth assumptions
Source: NS, Letter from the municipality of Hoogeveen to NS, dated 12 February 2009, Booz & Company analysis

NS's model is sensitive to changes in dwelling time at Hoogeveen, but still outputs a loss in passenger kilometers

Sensitivity analysis on dwelling time

for Hoogeveen as IC station

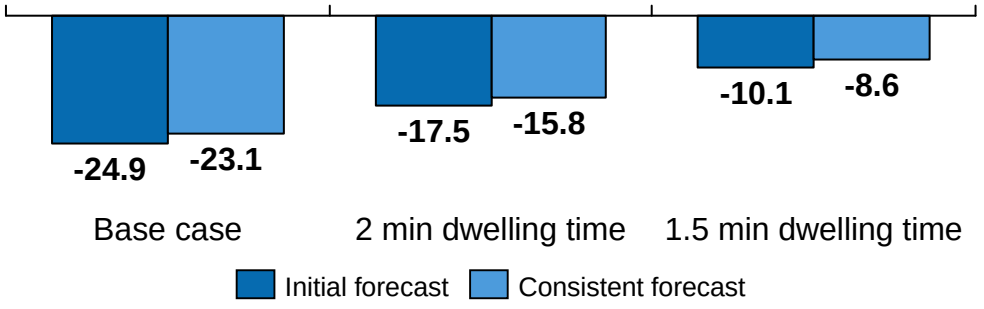
Initial NS forecast

	Dwelling time	Additional passenger kms	Additional trips
Hgv Alternative	1.5	-10,086	35
NS low	2	-17,491	-14
NS base	2.5	-24,895	-64
NS high	3	-32,299	-113

Sensitivity analyses on NS's initial and consistent forecasts

Impacts of Hgv IC stop in base case , 2 and 1.5 min dwelling time

Pass. kms x1000/day



Hoogeveen dwelling time

- We undertook sensitivity analyses on dwelling time at Hoogeveen station in NS's models
- NS indicated that the dwelling time at the Hoogeveen stop would be within the range of 2-3 minutes
- In their model calculation they use an average of 2.5 minute as NS operational models indicate a 2 minute stop from Groningen - Zwolle and a 3 minute stop vice versa is minimum
- The municipality of Hoogeveen, however, indicated that they believe 1.5 minutes would be achievable
- We used NS's model to calculate the impacts of the Hoogeveen stop using Hoogeveen's alternative dwelling time of 1.5 min
  - In that case, 10,000 passenger kilometers are lost, but trips are gained
  - These results are in line with the 8,600 passenger kilometers in the forecast based on consistent input data

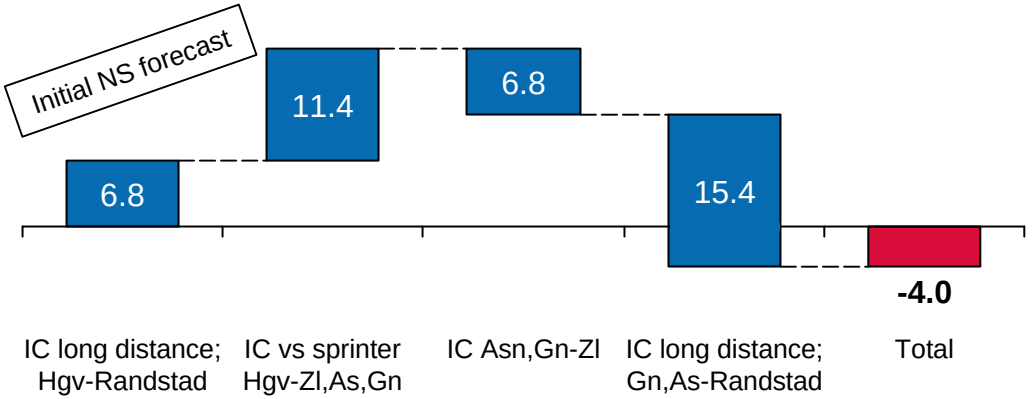
Note: Booz & Company have not assessed the plausibility of Hoogeveen's growth assumptions

Source: NS, Letter from the municipality of Hoogeveen to NS, dated 12 February 2009, Booz & Company analysis

Even in Hgv's most optimistic scenario, NS models indicate passenger kilometers lost when Hoogeveen is included as IC stop

Forecasted pass km loss breakdown with Hgv IC stop

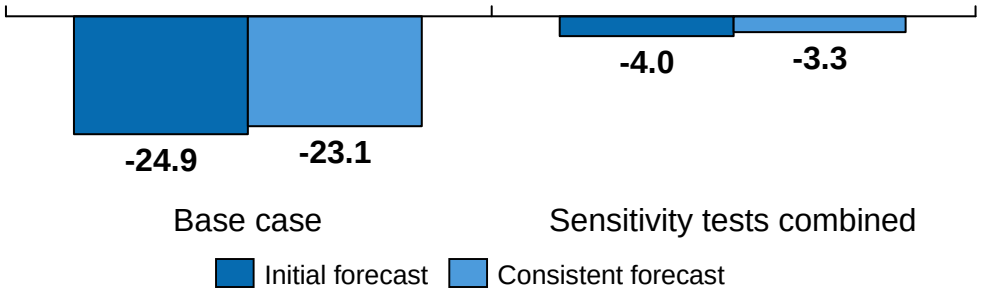
1.5 min dwelling time, 50% Hgv growth (1000 km/day)



Sensitivity analyses on NS's initial and consistent forecasts

Impacts of Hgv IC stop in base case and combined sensitivity tests

Pass. kms x1000/day



Comments

- For the most optimistic scenario for Hoogeveen the NS models indicate 4,000 passenger kilometers lost and 126 trips gained
  - We combined previous sensitivity analyses and thereby creating the most optimistic scenario for Hoogeveen: 1.5 min dwelling time and 50% growth
  - The additional trips gained still result in passenger kilometer lost as the trips gained are on short distances
- Both sensitivity analyses combined still result in passenger kilometers lost when Hoogeveen is added as IC stop, albeit less than in NS's base case

Note: Booz & Company have not assessed the plausibility of NS assumptions or Hoogeveen's alternative assumptions on dwelling time or growth

Source: NS, Booz & Company analysis