Input From the FORWARD Project Into the Development of a Complementary Freight Transport Policy

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PREFACE

This report presents results from a short-term study performed by the European-American Center for Policy Analysis (EAC) for the Netherlands Ministry of Transport, Public Works and Water Management. The aims of the study were:

- to provide information on the impacts of existing freight transport projects that would enable the Ministry to prioritize the projects based on their relative contributions to reaching the Minister's goals related to shifting freight onto the Betuveline (a new rail line for freight transport), shifting freight from road transport to alternative modes, and reducing the number of truck kilometers driven in the Netherlands;

- to sharpen the focus and scope of existing projects to increase their benefits;

- to assist the Ministry in identifying other promising policy actions.

The results of the study will be used by policymakers within the Ministry of Transport, Public Works and Water Management to prepare a 'complementary freight transport policy plan'. The primary aim of this policy would be to make the Betuveline a success in terms of the number of tonnes transported. Additional aims would be to realize a mode shift from road transport to alternative modes and to reduce the number of truck kilometers driven in the Netherlands. However, most of the conclusions and other information should also be directly applicable to similar freight transport issues in other countries.

The Ministerial project team that was tasked to prepare complementary freight transport policy plan was chaired by Drs. J.C. Gardenier of the Directorate of Transport. The study team that was formed to carry out the work included the following members:

- Dr. Manuel Carrillo (RAND)
- Dr. Jonathan Cave (EAC)
- Ing. Frits Cramer (Bakkenist Management Consultants)
- Drs. Paul van der Gaag (AVV)
- Drs. Mirjam van het Loo (EAC)
- Dr. ir. Marco Kerkhof (AVV)
- Ir. Hans van der Rest (AVV)
• Drs. Odette van de Riet (EAC)
• Dr. Warren Walker (EAC)

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SUMMARY

During the Parliamentary debate on the Betuweline in November 1995, the Minister of Transport, Public Works and Water Management promised Parliament to present a "complementary freight transport policy plan" in June 1996. The primary aim of this policy would be to make the Betuweline a success in terms of the number of tonnes transported. Additional aims would be to realize a mode shift from road transport to alternative modes and to reduce the number of truck kilometers driven in the Netherlands. A general condition was that all policy options should serve the nation’s transport policy goals in terms of sustainability, accessibility, economy, and employment.

It was intended that the plan would consist mainly of slightly revised versions of existing policy options, although it could be supplemented by new policy options.

Within the Ministry, a project team was tasked to prepare this policy. Its leader asked the Ministry’s Transport Research Centre (AVV) to provide input to his task using the methods, data, models, and results of the recently-completed FORWARD project (Freight Options for Road, Water, And Rail for the Dutch). AVV asked the European-American Center for Policy Analysis (EAC) to help with this job.

The aims of the study were:

- to provide information on the impacts of existing freight transport projects that would enable the Ministry to prioritize the projects based on their relative contributions to reaching the Minister’s goals;

- to sharpen the focus and scope of existing projects to increase their benefits;

- to assist the Ministry in identifying other promising policy actions.

The specific outputs requested by the Ministry were:

- The percentage change in the number of tonnes of freight carried on the Betuweline

- The percentage change in the share of freight (tonne kilometers) that is transported by non-road modes
- The percentage change in truck kilometers
- The percentage reduction in highway congestion
- The percentage reduction in road freight emissions of NOx
- The percentage reduction in road freight emissions of CO2
- The percentage change in value added and employment, for the transport sector and for the economy as a whole.

Note that cost was not included in the list of criteria.

Work on the study was split into two phases:
1. exploration, and
2. cluster analysis, which was further subdivided into five tasks:

2.1. Adapting the base case of PACE-FORWARD to include the Betuweline, and adding a capability to the model to produce the specific outputs required for this study.

2.2. Suggesting revisions or additions to the list of existing projects.

2.3. Producing quantitative assessments (from PACE-FORWARD runs) for each of the clusters of existing projects.

2.4. Producing rankings of the clusters based on a variety of objectives.

2.5. Drawing conclusions from the results of the first four tasks.

Task 2.2 resulted in a number of revisions and additions to the list of existing projects. In particular, an examination of promising FORWARD policy options that did not seem to be represented by any of the existing projects suggested that the following three new options might be tried:

- Equalize the rules of transport on own account and professional account
- Speed the exchange of cargo between road and rail
- Provide free transport of goods by rail

The examination of the existing projects suggested that many of them were quite limited in scope. Additional benefits might be obtained by expanding the scope of some of the projects to other modes, other
geographic locations, other types of enterprises, or other types of freight.

Task 2.5 led us to draw a number of conclusions. Overall, there is one project cluster that appears promising according to all criteria. This “robust cluster” is “build new rail spurs”. (But, it is important to remember that costs were not considered in creating the rankings.) Other high-ranked clusters were “settle appropriate (new) firms at water and rail”, “create multi-modal centers”, and “expand the infrastructure for rail.”

If the primary policy objective were to increase the number of tonnes transported over the Betuweline, then five clusters should be added to the top four clusters mentioned above: “free rail goods transport”, “increase diesel tax by Dfl 3.00/liter”, “expand the competition with Dutch Railways”, “speed up the exchange between road and rail”, and “international cooperation among railway companies.”

If the primary policy objective were to shift freight from road transport to alternative modes, then four clusters should be added to the top four clusters mentioned first: “free rail goods transport”, “increase diesel tax by Dfl 3.00/liter”, “build more waterways”, and “expand pipelines.”

If the primary policy objective were to reduce the number of truck kilometers driven in the Netherlands, then six clusters should be added to the top four clusters mentioned first: “use of telematics by transporters”, “require a minimum load factor for trucks”, “equalize the rights and duties of transport on own account and professional account”, “build more waterways”, “permit heavier trucks”, and “expand pipelines.”

We also looked at policy options that could reduce congestion and/or reduce the truck emissions of NOx or CO2. If the primary policy objectives were these, then three clusters should be added to the top four clusters mentioned first: “use of telematics by transporters”, “require a minimum load factor for trucks”, and “permit heavier trucks.”

We should sound a note of warning about the possible misinterpretation of the results of this study. Erroneous conclusions might be drawn about the value of some of the individual DGV projects. It is often inappropriate to extrapolate the results of a stand-alone pilot project to more widespread use.
This study focused on clusters of existing projects and not on individual projects. A logical next step would be to identify a few of the most promising project clusters and investigate them further. It might also be worthwhile to investigate possibilities for other promising projects.
BACKGROUND

During the Parliamentary debate on the Betuweline in November 1995, the Minister of Transport, Public Works and Water Management promised Parliament to present a "complementary freight transport policy plan" in June 1996. The primary aim of this policy would be to make the Betuweline a success in terms of the number of tonnes transported. Additional aims would be to realize a mode shift from road transport to alternative modes and to reduce the number of truck kilometers. A general condition would be that all policy options should serve the general SVV goals in terms of sustainability, accessibility, economy, and employment. It was intended that the plan would consist mainly of slightly revised versions of existing policy options, although it could be supplemented by new policy options.

Within the Ministry, a project team was was established, which was named Mobiel in Balans (MIB). The MIB project was tasked to prepare this complementary freight transport policy. It received support and guidance from an existing Ministerial management team. In addition, an interdepartmental steering group and an external 'sounding board' were set up, a Ministerial working group was formed whose major task was to make an inventory of the existing policy activities within the Ministry, and an 'elaboration group' was installed to work out ideas for new policy actions.

The MIB project team, chaired by Drs. J.C. Gardenier of the Directorate of Transport, asked the Ministry's Transport Research Centre (AVV) for help in evaluating existing Ministerial freight transport projects using the methods, data, models, and results of the Freight Options for Road, Water, And Rail for the Dutch (FORWARD) project. The AVV asked the European-American Center for Policy Analysis (EAC), which is part of RAND, for help with this job. The FORWARD project is a major transport policy analysis that was recently performed by the EAC for the Ministry1.

The aims of our study were:

- to provide information on the impacts of existing freight transport projects that would enable the Ministry to prioritize

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1 See Hillestad, et al. [1996a] for an overview of the FORWARD project and its results.
the projects based on their relative contributions to reaching
the Minister's goals:

- to sharpen the focus and scope of existing projects to
  increase their benefits;

- to assist the Ministry in identifying other promising policy
  actions.

The request for assistance was relayed to the EAC by Drs. P.B.
vander Gaag of the Transport Research Centre of the Ministry (AVV).
As a result, a joint study team was formed to carry out the work. The
team members included the following:

- Dr. Manuel Carrillo (RAND)
- Dr. Jonathan Cave (EAC)
- Ing. Frits Cramer (Bakkenist Management Consultants)
- Drs. Paul van der Gaag (AVV)
- Drs. Mirjam van het Loo (EAC)
- Dr. ir. Marco Kerkhof (AVV)
- Ir. Hans van der Rest (AVV)
- Drs. Odette van de Riet (EAC)
- Dr. Warren Walker (EAC)

Work on the study was split into two phases:
1. exploration, and
2. cluster analysis, which was further subdivided into five tasks:

   2.1. Adapting the base case of PACE-FORWARD to include the
        Betuveline, and adding a capability to the model to
        produce the specific outputs required for this study.

   2.2. Suggesting revisions or additions to the list of
        existing projects.

   2.3. Producing quantitative assessments (from PACE-FORWARD
        runs) for each of the clusters of existing projects.

   2.4. Producing rankings of the clusters based on a variety
        of objectives.

   2.5. Drawing conclusions from the results of the first
        four tasks.

The following sections of this report summarize the tasks carried out
in each phase. The final section discusses possible future activities
in the study.
PHASE 1: EXPLORATION

The entire study was based on an examination of the 135 existing Ministerial freight transport projects listed in a recent inventory [Huysser, et al., 1996]. In what follows, we call these projects the DGV projects.

The first task was to link the DGV projects to FORWARD tactics (the policy options that were evaluated in the FORWARD project)\(^2\). Based on the information in the inventory, we assigned each project to one of four categories:

1. Real Tactic (RT): a project that represented a policy action that might be expected to reduce the number of truck kilometers (by improving road transport efficiency or producing mode shift)

2. Not A Real Tactic (NART): a project that was limited to initiating/developing a procedure, research project, survey, discussion, etc., but would not, by itself, produce a change in the performance of the freight transport system.

3. Beyond the Scope (BS): a project that might be a real tactic, but that was not aimed at reducing the number of truck kilometers.

4. Unclear (UC): a project whose description in the inventory made it unclear whether it was or was not a real tactic.

We tried to associate as many projects as possible with FORWARD tactics whose effects were estimated by PACE-FORWARD, the policy analysis model that was developed as part of the FORWARD project. (See Carrillo [1995] for further information about PACE-FORWARD.) Then, we grouped the projects into 27 clusters, according to their associated FORWARD tactic. These clusters are listed in Appendix B. Appendix D describes how each of these tactics was implemented in PACE-FORWARD or otherwise treated during the FORWARD project.

For cases in which the aim of a DGV project or its association with a FORWARD tactic was unclear, we contacted the DGV project leader to obtain additional information.

The exercise described above produced a great deal of information, which we summarized in a matrix. Appendix A contains this matrix.

\(^2\) Descriptions of all of the FORWARD tactics can be found in the appendices of Hillestad, et al. [1996b].
TASK 2.1: ADAPTING PACE-FORWARD

We decided that the base case for estimating the impacts in this study would be represented in PACE-FORWARD by the situation (freight demands and amounts being transported by mode) found in the European Renaissance scenario for the year 2015 with no tactics besides the Betuweline implemented. This is roughly the same base case as was used in the Hermans Commission study [Commissie Betuweroute Rapport, 1995]. This enabled us to use PACE-FORWARD to obtain upper-bound estimates on the DGV project clusters assuming the Betuweline was already implemented.

We assigned all Dutch railway transport from Rotterdam to Germany and points beyond to this Betuweline.\(^3\) This is consistent with the approach taken in the Hermans Commission study. Mode shift computations in tonne-km terms were adjusted for this shorter route.

The specific outputs requested by the Ministry were:

- The percentage change in the number of tonnes of freight carried on the Betuweline
- The percentage change in the share of freight (tonne kilometers) that is transported by non-road modes
- The percentage change in truck kilometers
- The percentage reduction in highway congestion
- The percentage reduction in road freight emissions of NOx
- The percentage reduction in road freight emissions of CO2
- The percentage change in value added and employment, for the transport sector and for the economy as a whole.

Modifications were made to PACE-FORWARD so that it produced these outputs for each of the DGV project clusters to be assessed.

\(^3\) We used the following approach to constructing the base case. The underlying scenario given by the NEA demand data describes freight flows by origin, destination, region (each region traversed en route from origin to destination), and commodity group. In PACE-FORWARD terms, the traffic most affected by the Betuweline is that between Rotterdam and the Ruhr region, and that between Rotterdam and the "other countries" region. For this exercise, we assigned to the Betuweline all rail traffic shipped between these origin-destination pairs (regardless of the route it originally followed between Rotterdam and Germany). This reduced the total distance to be traveled by this rail freight to 112 km, but left road traffic along the corridor intact.
TASK 2.2: POSSIBILITIES FOR ADDITIONAL DGV PROJECTS

We suggested revisions or additions to the list of DGV projects based on:

a. Identification of promising FORWARD tactics that are not represented by DGV projects.

b. Systematic analysis of the DGV projects in each of the clusters to identify possible lacunae in the set of projects.

These revisions and additions are described below.

SUGGESTIONS BASED ON THE OUTCOMES OF THE FORWARD STUDY

In the FORWARD project, twelve illustrative strategies were developed (see Hillestad, et al., [1996b], Sec. 7). Since the aim of the complementary freight transport policy would be to reduce the growth in truck traffic in favor of alternative modes, we examined the Transport Efficiency Strategy and the Mode Shift Strategy to see if we could find promising FORWARD tactics that did not seem to be represented by any of the DGV projects. The results of this effort might give the Ministry some ideas for new projects to try.

We identified three possibilities:

- Tactic 6.08: Equalize the rules of transport on own account and on professional account
- Tactic 4.05: Speed the exchange of cargo between road and rail
- Tactic 4.06: Provide free transport of goods by rail

These tactics are described in Appendix D. To provide insights into the possible performance of these tactics compared to the DGV projects evaluated in this study, we included the three tactics in the PACE-FORWARD runs that we made.
SUGGESTIONS BASED ON IDENTIFICATION OF LACUNAE IN THE CLUSTERS

In this subtask we performed a systematic analysis of each of the DGV clusters to see if the projects in the cluster covered all of the possibilities inherent in the corresponding FORWARD tactic. Where some aspects appeared to not be covered, we identified them as lacunae. We found lacunae in 9 of the 27 clusters. In general, we found that the projects were limited in scope. It appears that additional benefits might be obtained by expanding the projects’ scope to other modes, other geographic locations, other types of enterprises, or other types of freight. In fact, we are concerned that erroneous conclusions might be drawn about the value of some of the projects. It is often inappropriate to extrapolate the results of a stand-alone pilot project to more widespread use. In the case of city distribution centers (DGV Project Cluster 10.02), for example, a single center might be unsuccessful, while a network of centers is more likely to succeed.

The lacunae are described in Appendix C.

TASK 2.3: PACE-FORWARD RESULTS

Appendix E contains the PACE-FORWARD output for each of the 27 DGV project clusters that are listed in Appendix B and for the three promising FORWARD tactics that are not represented by any of the DGV projects.

The output is in the form of a matrix. The rows of the matrix are the 30 FORWARD tactics that were evaluated in this study. (Results for the three suggested additional projects mentioned in Appendix C are given in bold.) The columns are the estimated impacts of the tactics. The base case for estimating impacts is given by the situation (freight demands, amounts being transported by mode) in the European Renaissance scenario for the year 2015, with no tactics besides the Betuweline implemented. The estimated impacts are all upper bounds on what might be expected from the implementation of the tactics.
TASK 2.4: RANKINGS

Four different rankings were produced, based on:

- The percentage change in the number of tonnes of freight carried on the Betuwelijn, compared to the base case (in decreasing order)
- The percentage change in the share of freight (tonnes) that is transported by non-road modes (in decreasing order)
- The percentage change in truck kilometers (in increasing order; i.e., the biggest reduction is first)
- A weighted average of the measures used to create the first two rankings. Equal weights (0.5) are assigned to the two measures.

The results from this task are presented in Table 1. The rankings are shown in the form of a matrix. The first row of the matrix shows the highest-ranked FORWARD tactic for each of the four rankings; the second row shows the second-ranked tactic; etc. The first column identifies the ranking. The remaining four columns show the rankings based on the four criteria listed above. Only those tactics for which the changes were more than one percent for the specified criterion are shown in the ranked list for that criterion.

In order to facilitate drawing conclusions from the information in Table 1, we summarized the rankings in a matrix that shows the top ten FORWARD tactics for each of the four ranking criteria. The FORWARD tactics are listed in numerical order. The numbers in the matrix reflect the ranking of the tactic for the criterion specified at the top of the column (number 1 is the highest ranked tactic). This matrix is given in Table 2.
<table>
<thead>
<tr>
<th>Ranking</th>
<th>Criterion 1: Betuzeline</th>
<th>Criterion 2: Change in all</th>
<th>Criterion 3: Change in truck</th>
<th>Criterion 1+2: Weighted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tonnes as % increase over baseline</td>
<td>mode share as % of baseline (by TKm)</td>
<td>kilometers as % of baseline</td>
<td>average using equal weights</td>
</tr>
<tr>
<td>1</td>
<td>4.04 Build new spurs</td>
<td>4.04 Build new spurs</td>
<td>6.041 Use telematics by transporters</td>
<td>4.04 Build new spurs</td>
</tr>
<tr>
<td>2</td>
<td>2.06 Create multi-modal centres</td>
<td>3.08 Build more waterways</td>
<td>6.02 Require a minimum load factor of trucks</td>
<td>2.06 Create multi-modal centres</td>
</tr>
<tr>
<td>3</td>
<td>4.06 Free rail goods transport</td>
<td>2.02 Settle appropriate (new) firms at water and rail</td>
<td>4.04 Build new spurs</td>
<td>4.06 Free rail goods transport</td>
</tr>
<tr>
<td>4</td>
<td>4.02 Expand the infrastructure for rail</td>
<td>2.06 Create multi-modal centres</td>
<td>6.08 Equalize the rights and duties of transport on own account and professional account</td>
<td>4.02 Expand the infrastructure for rail</td>
</tr>
<tr>
<td>5</td>
<td>2.02 Settle appropriate (new) firms at water and rail</td>
<td>11.025 Expand pipelines (comb. of 11.021&amp;11.022)</td>
<td>3.08 Build more waterways</td>
<td>2.02 Settle appropriate (new) firms at water and rail</td>
</tr>
<tr>
<td>6</td>
<td>4.01 Expand the competition with Dutch Railways (NS)</td>
<td>4.02 Expand the infrastructure for rail</td>
<td>2.02 Settle appropriate (new) firms at water and rail</td>
<td>5.01b Increase diesel tax by Dfl 3.00/litre for environmental costs</td>
</tr>
<tr>
<td>7</td>
<td>4.05 Speed up the exchange between road and rail</td>
<td>4.06 Free rail goods transport</td>
<td>6.011 Permit heavier trucks</td>
<td>4.01 Expand the competition with Dutch Railways (NS)</td>
</tr>
<tr>
<td>8</td>
<td>5.01b Increase diesel tax by Dfl 3.00/litre for environmental costs</td>
<td>5.01b Increase diesel tax by Dfl 3.00/litre for environmental costs</td>
<td>2.06 Create multi-modal centres</td>
<td>4.05 Speed up the exchange between road and rail</td>
</tr>
<tr>
<td>9</td>
<td>4.10 International cooperation among railway companies</td>
<td>11.032 Use moving sidewalk for containers internationally from Rotterdam</td>
<td>11.025 Expand pipelines (comb. of 11.021 &amp; 11.022)</td>
<td>3.08 Build more waterways</td>
</tr>
<tr>
<td>10</td>
<td>3.32 Provide free transport of goods by water</td>
<td>4.02 Expand the infrastructure for rail</td>
<td>4.02 Expand the infrastructure for rail</td>
<td>4.10 International cooperation among railway companies</td>
</tr>
<tr>
<td>11</td>
<td>5.01 Increase excise duty on diesel fuel to include environmental costs</td>
<td>6.042 Use telematics for combined transport</td>
<td>6.01 Enlarge sizes and weights of trucks</td>
<td>5.01 Increase excise duty on diesel fuel to include environmental costs</td>
</tr>
<tr>
<td>12</td>
<td>4.01 Expand the competition with Dutch Railways (NS)</td>
<td>4.01b Increase diesel tax by Dfl 3.00/litre for environmental costs</td>
<td>11.025 Expand pipelines (comb. of 11.021 &amp; 11.022)</td>
<td>11.032 Use moving sidewalk for containers internationally from Rotterdam</td>
</tr>
<tr>
<td>13</td>
<td>4.05 Speed up the exchange between road and rail</td>
<td>4.06 Free rail goods transport</td>
<td>4.05 Speed up the exchange between road and rail</td>
<td>11.032 Use moving sidewalk for containers internationally from Rotterdam</td>
</tr>
<tr>
<td>14</td>
<td>10.02 Expand distribution centres within towns</td>
<td>11.032 Use moving sidewalk for containers internationally from Rotterdam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>11.032 Use moving sidewalk for containers internationally from Rotterdam</td>
<td>3.32 Provide free transport of goods by water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>6.042 Use telematics for combined transport</td>
<td>3.32 Provide free transport of goods by water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>4.01 Expand the competition with Dutch Railways (NS)</td>
<td>6.042 Use telematics for combined transport</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
**Table 2**

Summary of Rankings

<table>
<thead>
<tr>
<th>FORWARD Tactic</th>
<th>Criterion 1: Betuwe line Tonnes as % increase over baseline</th>
<th>Criterion 2: Change in alt. mode share as % of baseline (by T/km)</th>
<th>Criterion 3: Change in truck kilometers as % of baseline</th>
<th>Criterion 1+2: Weighted average using equal weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.02 Settle appropriate (new) firms at water and rail</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>2.06 Create multi-modal centres</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>3.01 Improve internal logistics in Rotterdam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.08 Build more waterways</td>
<td></td>
<td>2</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>3.32 Provide free transport of goods by water</td>
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<td>10</td>
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<td></td>
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</tr>
<tr>
<td>4.02 Expand the infrastructure for rail</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>4.04 Build new spurs</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4.05 Speed up the exchange between road and rail</td>
<td>7</td>
<td></td>
<td></td>
<td>8</td>
</tr>
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<td>4.06 Free rail goods transport</td>
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</tr>
<tr>
<td>4.10 International cooperation among railway companies</td>
<td></td>
<td>9</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>4.14 Introduce fast freight trains</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5.01b Increase diesel tax by Dfl 3.00/liter for environmental costs</td>
<td>8</td>
<td>9</td>
<td></td>
<td>6</td>
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<tr>
<td>6.01 Enlarge sizes and weights of trucks</td>
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<tr>
<td>6.011 Permit Heavier trucks</td>
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<td></td>
<td>7</td>
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<tr>
<td>6.02 Require a minimum load factor of trucks</td>
<td></td>
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<td>2</td>
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<tr>
<td>6.041 Use telematics by transporters</td>
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<tr>
<td>6.042 Use telematics for combined transport</td>
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<tr>
<td>6.08 Equalize the rights and duties of transport on own account and professional account</td>
<td></td>
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<td>4</td>
<td></td>
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<tr>
<td>7.02 Use speed limiters</td>
<td></td>
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</tr>
<tr>
<td>9.01 Compel to drive at night</td>
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<tr>
<td>10.02 Expand distribution centres within towns</td>
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<tr>
<td>11.025 Expand pipelines (comb. of 11.021&amp;11.022)</td>
<td></td>
<td></td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>11.032 Use moving sidewalk for containers internationally from Rotterdam</td>
<td></td>
<td></td>
<td></td>
<td>9</td>
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<tr>
<td>11.05 Stimulate short sea transport</td>
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</tbody>
</table>
An examination of the results presented in Appendix E and in Tables 1 and 2 leads us to draw several conclusions, which are summarized below.

OVERALL CONCLUSIONS

Table 2 presents the top ten rankings of DGV project clusters for four different criteria:

1. The percentage change in the number of tonnes of freight carried on the Betuweline, compared to the base case (in decreasing order)

2. The percentage change in the share of freight (tonnes) that is transported by non-road modes (in decreasing order)

3. The percentage change in truck kilometers (in increasing order; i.e., the biggest reduction is first)

4. A weighted average of the measures used to create the first two rankings. Equal weights (0.5) are assigned to the two measures.

There is one project cluster that appears promising no matter which criterion is chosen:

- Build new rail spurs (DGV project cluster 4.04)

This cluster appears first on three of the four ranked lists, and appears third on the other. Three other clusters appear within the top ten of all four ranked lists:

- Settle appropriate (new) firms at water and rail (DGV project cluster 2.02)
- Create multi-modal centers (DGV project cluster 2.06)
- Expand the infrastructure for rail (DGV project cluster 4.02)

The DGV projects that are related to the above four clusters, therefore, are representative of the most promising actions that the government could take overall.

Preferences for the other clusters depend on the criterion considered most important. There is a high correlation between the rankings for Criterion 1 (change in tonnes carried on the Betuweline) and Criterion 2 (change in mode share). This also produces a high
correlation with the rankings in Criteria 1 + 2 (the weighted ranking). The ranking for Criterion 3 (change in truck kilometers) is considerably different from the other three. This means that, aside from the overall top four, clusters that are preferred from a truck kilometer reduction point of view are not the ones preferred from a Betuweline or mode shift point of view, and vice versa. We discuss these two sets of rankings, as well as the rankings for criteria related to emissions and congestion, below.

We should also note that the three tactics that were found to be promising in the FORWARD project but that did not seem to be represented by any of the DGV projects (Tactics 4.05, 4.06, and 6.08) did respectably well in the rankings, but are not among the overall top four.

**Betuweline Tonnes and Mode Share**

In addition to the overall top four (DGV project clusters 4.04, 2.02, 2.06, and 4.02), we estimate there would be significant changes in the values of both the amount of Betuweline tonnes and mode share from the following clusters and FORWARD tactics (listed in order of their desirability):

- Free rail goods transport (FORWARD tactic 4.06)
- Increase diesel tax by Dfl 3.00/liter (DGV project cluster 5.01b)

If Betuweline tonnes is considered to be more important than mode share, then three other clusters and FORWARD tactics have significant impacts:

- Expand the competition with Dutch Railways (DGV project cluster 4.01)
- Speed up the exchange between road and rail (FORWARD tactic 4.05)
- International cooperation among railway companies (DGV project cluster 4.10)

However, these clusters have very little impact on mode share.

If mode share is considered to be more important than Betuweline tonnes, then two other clusters have significant impacts:

- Build more waterways (DGV project cluster 3.08)
- Expand pipelines (a cluster that combines FORWARD tactics 11.021 and 11.022)
However, these clusters have no impact on Betuwe line tonnes.

TRUCK KILOMETERS

In addition to the overall top four (DGV project clusters 4.04, 2.02, 2.06, and 4.02), we estimate there would be significant reductions in truck kilometers from the following clusters and FORWARD tactics (listed in order of their desirability):

- Use of telematics by transporters (DGV project cluster 6.041)
- Require a minimum load factor for trucks (DGV project cluster 6.02)
- Equalize the rights and duties of transport on own account and professional account (FORWARD tactic 6.08)
- Build more waterways (DGV project cluster 3.08)
- Permit heavier trucks (DGV project cluster 6.011)
- Expand pipelines (a DGV project cluster that combines FORWARD tactics 11.021 and 11.022)

NOX, CO2, AND CONGESTION

In addition to the overall top four (DGV project clusters 4.04, 2.02, 2.06, and 4.02), all of the clusters that appear at the top of the rankings for the criteria discussed above are also likely to produce substantial decreases in congestion and in emissions of NOx and CO2. However, the largest reductions in these three measures can be expected from clusters that are focused on improving transport efficiency; i.e., clusters that aim to decrease the number of truck kilometers through efficiency improvements. The best of these are:

- Use of telematics by transporters (DGV project cluster 6.041)
- Require a minimum load factor for trucks (DGV project cluster 6.02)
- Permit heavier trucks (DGV project cluster 6.011)
POSSIBLE NEXT STEPS

Phases 1 and 2 focused on clusters of DGV projects and not individual projects. A logical next step would be to identify a few of the most promising DGV project clusters and investigate them further, and to investigate possibilities for other promising projects. In particular, the next phase might include the following three tasks:

1. Translate those DGV projects that are analogous to one or more FORWARD tactics into parameters of PACE-FORWARD and assess their impacts.

2. Identify DGV projects that are not analogous to any FORWARD tactics but that can be easily modeled in PACE-FORWARD, translate them into parameters of PACE-FORWARD, and assess their impacts.

3. Identify FORWARD tactics that appear to be promising in light of the Betuweline, and that are not represented by any of the DGV projects.

Tasks 1 and 2 would include some literature review and consultation with DGV project leaders, in order to collect the information that would enable the projects to be modeled in PACE-FORWARD.
APPENDIX A

INFORMATION ON DGV PROJECTS

This appendix contains a matrix that lists each of the 135 DGV projects mentioned in [Huyser, et al., 1996], provides some information about the project, and shows how the project was treated in our study. The matrix has the following format:

Column A: The identification number of the DGV project, as given in [Huyser, et al., 1996].

Column B: The type of project (RT, NART, BS, or UC), where these abbreviations mean the following:

Real Tactic (RT): a project that represented a policy action that might be expected to reduce the number of truck kilometers (by improving road transport efficiency or producing mode shift).

Not A Real Tactic (NART): a project that was limited to initiating/developing a procedure, research project, survey, discussion, etc., but would not, by itself, produce a change in the performance of the freight transport system.

Beyond the Scope (BS): a project that might be a real tactic, but that was not aimed at reducing the number of truck kilometers.

Unclear (UC): a project whose description in the inventory made it unclear whether it was a real tactic or not a real tactic.

Column C: The number of the associated FORWARD tactic (if any).

Column D: An explanation of why the project was categorized as BS or NART, and/or an explanation of the aim of the project as it was explained to us by the DGV project leader.

Column E: The title of the DGV project, as given in [Huyser, et al., 1996].

Column F: The description of the DGV project, as given in [Huyser, et al., 1996].

Column G: The aim of the DGV project, as given in [Huyser, et al., 1996].
APPENDIX B

DGV PROJECT CLUSTERS

This appendix shows the assignment of DGV projects to clusters. Each cluster is associated with a different FORWARD tactic. We were able to associate 80 of the 135 DGV projects with a FORWARD tactic. This produced 27 clusters. The table on the following pages consists of three columns:

Column 1: FORWARD tactic number that identifies the cluster. The results in Appendix E are the outputs from PACE-FORWARD for this tactic.

Column 2: The name of the FORWARD tactic. Appendix D provides a description of the tactic, and explains how it was implemented in PACE-FORWARD.

Column 3: The set of DGV projects that are included in the cluster. The number given is the identification number used in [Huyser, et al., 1996]. Appendix A includes a description of the projects.

Note the following:

• FORWARD tactics 5.01, 5.02, and 5.03 are all implemented in the same way in PACE-FORWARD. All three increase the relative cost of road transport and, thereby, cause a shift to other modes. For purposes of this project, we chose to estimate the effects DGV project G2.04 by using FORWARD tactic 5.01b (increasing the tax on diesel fuel by Dfl 3/liter).

• To get upper bounds on the impacts of using pipelines as an alternate mode of transport, we combined the impacts of FORWARD Tactic 11.021 (Make better use of the existing network of pipelines) and Tactic 11.022 (Expand the network of pipelines). The combined tactic is labeled Tactic 11.025.
<table>
<thead>
<tr>
<th>FORWARDED tactic number</th>
<th>FORWARDED tactic name</th>
<th>DGV PROJECTS INCLUDED IN CLUSTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.02</td>
<td>Settle new firms near rail/water</td>
<td>G6.06</td>
</tr>
<tr>
<td>2.06</td>
<td>Build multimodal centers</td>
<td>G0.05, G2.02, G2.15, G2.16, G3.03, G3.20, G7.02</td>
</tr>
<tr>
<td>3.01</td>
<td>Improve internal logistics Rotterdam</td>
<td>G2.08, G3.06, G4.22, G6.03</td>
</tr>
<tr>
<td>3.08</td>
<td>Expand waterway infrastructure</td>
<td>G3.07, G3.09, G3.15</td>
</tr>
<tr>
<td>3.10</td>
<td>Cancel the system of equal distribution of cargo for shipping</td>
<td>G3.11</td>
</tr>
<tr>
<td>3.11</td>
<td>Use stackable swap bodies and design ships for this kind of transport</td>
<td>G3.13, G3.14</td>
</tr>
<tr>
<td>3.18</td>
<td>Reduce empty ship trips</td>
<td>G3.02, G3.04, G6.12</td>
</tr>
<tr>
<td>3.32</td>
<td>Free inland shipping transport</td>
<td>G3.05, G3.16, G3.17</td>
</tr>
<tr>
<td>4.01</td>
<td>Expand competition for NS</td>
<td>G4.02, G4.04, G4.06, G4.12, G4.13</td>
</tr>
<tr>
<td>4.02</td>
<td>Expand rail infrastructure</td>
<td>G4.18, G4.24</td>
</tr>
<tr>
<td>4.04</td>
<td>Build new rail spurs</td>
<td>G4.17</td>
</tr>
<tr>
<td>4.10</td>
<td>Improve international rail cooperation</td>
<td>G4.07, G4.08, G4.20</td>
</tr>
<tr>
<td>4.12</td>
<td>Improve existing rail infrastructure</td>
<td>G4.23, G4.26</td>
</tr>
<tr>
<td>4.14</td>
<td>Introduce fast freight trains</td>
<td>G4.14</td>
</tr>
</tbody>
</table>

-B.2-
<table>
<thead>
<tr>
<th>FORWARD tactic number</th>
<th>FORWARD tactic name</th>
<th>DGV PROJECTS INCLUDED IN CLUSTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.01+5.03+5.04 (this combination is treated as 5.01 in the impact assessment)</td>
<td>Impose excise duty on diesel fuel + Increase motor vehicle tax + Introduce tolls on roads</td>
<td>G2.04</td>
</tr>
<tr>
<td>6.01</td>
<td>Enlarge truck sizes and weights</td>
<td>G2.31</td>
</tr>
<tr>
<td>6.011</td>
<td>Permit heavier trucks</td>
<td>G2.13</td>
</tr>
<tr>
<td>6.02</td>
<td>Increase load factor of trucks</td>
<td>G2.14, G2.18, G2.19, G2.20, G2.21, G2.22, G2.23, G2.24, G2.25, G2.26, G2.27, G2.28, G2.29</td>
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<tr>
<td>6.041</td>
<td>Telematics for road transport</td>
<td>G6.08, G6.11</td>
</tr>
<tr>
<td>7.02</td>
<td>Use speed limiters for trucks</td>
<td>G2.10</td>
</tr>
<tr>
<td>7.04</td>
<td>Use separate lanes for trucks</td>
<td>G2.06, G2.07</td>
</tr>
<tr>
<td>9.01</td>
<td>Compel trucks to drive at night</td>
<td>G2.11</td>
</tr>
<tr>
<td>10.02</td>
<td>City distribution centers</td>
<td>G2.09</td>
</tr>
<tr>
<td>11.021+11.022 (this combination is treated as 11.025 in the impact assessment)</td>
<td>Use current pipelines + Expand pipeline infrastructure</td>
<td>G6.01</td>
</tr>
<tr>
<td>11.032</td>
<td>Moving sidewalks for containers (Netherlands)</td>
<td>G6.04</td>
</tr>
<tr>
<td>11.05</td>
<td>Stimulate short sea transport</td>
<td>G0.01, G0.02, G0.03, G0.04, G0.06</td>
</tr>
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<td>CLUSTER</td>
<td>DGV PROJECTS INCLUDED IN CLUSTER</td>
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<tr>
<td>FORWARD tactic number</td>
<td>FORWARD tactic name</td>
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<td>G1.11</td>
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</tbody>
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APPENDIX C

LACUNAE IN THE DGV PROJECT CLUSTERS

Cluster FORWARD Tactic 3.01: Improve Internal Logistics in Rotterdam
This cluster consists of four DGV projects. The first is a test with 4 TEU-trucks in order to decrease the trips with empty containers (G2.08). The second project is research on stimuli to develop efficient transhipment technology from sea to inland waterways (G3.06). The third is aimed at improving the logistics of rail transport in Rotterdam (G4.22). And the fourth is the development of a vision on infrastructure development for logistical container transport. This project is called Inco Maas (G6.03). A project that is not mentioned in this cluster, but that could contribute to an improvement of the internal logistics in Rotterdam, is to use Inco Maas for non-container transport.

Cluster FORWARD Tactic 3.11: Use Stackable Swap Bodies And Design Ships For This Kind Of Transport
The DGV project in this cluster is directed at stimulating the development of a standard land container for continental transport as an alternative to the non-stackable swap body (G3.18). An element that could be added to this project is the adaptation of ships for this kind of transport.

Cluster FORWARD Tactic 4.12: Improve Existing Rail Infrastructure
Two DGV projects are part of this cluster. The first project is the development of a vision on the internal and external safety of rail transport (G4.23). The second project is study on the feasibility of a national rail distribution network by NS-cargo, including a possible revitalization of several places to load and unload freight (G4.26). An additional project in this cluster is to perform research on the possibilities to increase the capacity of the current rail infrastructure by using different equipment and different operational procedures.

Cluster FORWARD Tactics 5.01 + 5.03 + 5.04: Impose Excise Duties On Fuel Diesel + Increase Motor Vehicle Tax + Introduce Tolls On Roads
The DGV project that relates to these tactics is the one on internalization of external costs (G2.04). A goal that could be added to this project is to minimize the overall external costs over all modes.

Cluster FORWARD Tactic 6.01: Enlarge Truck Sizes and Weights
The DGV project in this cluster is directed at the development of a FOCWA cold-storage trailer (G2.31). The scope of this project could be expanded in two ways: (1) to include all types of trailers and trucks, and (2) to research the possibilities of enlarging the volume of trucks without changing the law regarding the maximum weight of trucks.
Cluster FORWARD Tactic 6.02: Increase Load Factor of Trucks

Thirteen different DGV projects belong to this cluster. Below is a short description of each of them.

G2.14: Reduce the number of empty trips in the transportation of sea containers by road.

G2.18: Efficiency scan to improve the logistics of private enterprises.

G2.19: Introduction of a new logistical concept in the household and business moving sector.

G2.20: Introduction of a new logistical concept in international distribution.

G2.21: Improvement of efficiency in the "paneermeel" industry.

G2.22: Integration of the national distribution and collection activities of Scansped.

G2.23: Increase the load factor in ornamental plant transport by use of EDI.

G2.25: Declaration of intent by cooperating transporters of sea containers to reduce their number of empty trips.

G2.26: Declaration of intent by transporters (and forwarders) in the region Tilburg to improve efficiency.

G2.27: Optimization of the transport planning process of a large bulk transporter (Cehavé).

G2.28: Use night transport (inland) to transport beets and pulp in the sugar industry.

G2.29: Introduce a new logistical concept (delivery of complete packages) into the transport of food, non-food, and drinks.

G2.24: Decentralized planning and distribution at De Klok BV.

The efficiency scan mentioned in G2.18 pays attention to the logistics of all kinds of private enterprises and types of freight. The other projects focus on specific enterprises and types of freight. They could profit from an enlargement of their scope.

Cluster FORWARD Tactic 6.041: Telematics for Road Transport

The DGV projects in this cluster are the use of satellites to improve efficiency in road transport (G6.08) and the introduction of telematics (Tracer) for drivers on own account (G6.11). We suggest finding out if Tracer could be introduced into the whole (external) chain of transport.

Cluster FORWARD Tactic 6.042: Telematics for Combined Transport

There are six different DGV projects in this cluster:

G3.23: Development of an electronic market to tune supply and demand in inland shipping.

G6.02: Speeding up the container flows in the Rotterdam harbor by using a Smart Card (a fraud-proof identification and registration card) or EDI.
G6.10: Integration of the communication between warehousing and rail transport on the rail line between Rotterdam and Veendam.

G6.13: Tracking and tracing of vehicles in the intermodal chain by improving communication.


The integrated use of communication and tracking among all different modes could be added to these projects.

**Cluster FORWARD Tactic 10.02: City Distribution Centers**

The DGV project in this cluster is aimed at distribution in the Randstad (G2.09). Attention could be paid to other parts of the Netherlands as well. It should be noted that only a widespread network will make this project work in practice. (This is a danger inherent in many of the pilot projects. It is often inappropriate to extrapolate the results of a stand-alone pilot project to more widespread use. In the case of city distribution centers, for example, a network of such centers would be needed to make the concept work.)
APPENDIX D

TREATMENT OF FORWARD TACTICS THAT ARE ASSOCIATED WITH DGV PROJECT CLUSTERS OR ARE SUGGESTED ADDITIONS

Tactic 2.02-Settle Appropriate New Firms Near Water Or Rail

We assumed that existing firms would continue to ship their goods as they are projected to do so in the 2015 demand data. This tactic attempts to settle new firms that might have used road transportation close to water or rail facilities so that they can use alternative modes of transportation instead. This specification is based on CFB predictions of changes in employment and the life cycle of organizations by scenario for SBI sectors 2/3 (manufacturing). These sectors are most likely to see new firms established in the future that would be able to settle near railroads and waterways and use these modes of transport. We calculated an expected number of new firms for each of the economic scenarios. We then assumed that half of these firms could be induced to settle near either water or rail facilities and that these firms would in general be only 70 percent as large as the average existing firms. We assumed that the modal split for shifted freight would be 20 percent to rail and 80 percent to water. This analysis should probably produce an upper bound on effects and a lower bound on costs. We do not know how the program would be implemented, so we made no attempt to estimate the costs of administration or implementation. Moreover, our assumptions probably overestimated the number of firms that could easily be encouraged to settle near existing water or rail facilities.

Tactic 2.06-Create Multimodal Centers

This tactic would create multimodal centers to speed transshipment of freight between different modes and to stimulate the use of rail and water for transport. These centers would be located at the 12 joint road-rail or road-water nodes on the PACE-FORWARD network where such terminals do not now exist. To estimate the effects we calculated the change in transport times by mode and affected link using the procedures developed by NEI for the Tendbreuk Study, incorporating additional time for the pre- and post-rail and water transport by road that would be required. We assumed rail, water, and road speeds of 41 kph, 10 kph, and 80 kph (25 kph in urban areas) and that transfer times between modes would be reduced from 12 hours to 1 hour by the presence of an appropriate multimodal center. We then converted these reduced transport times into equivalent cost changes using the data developed by the Hague Consulting Group. With this information we calculated expected mode shifts for both national and international freight for each affected link, using data from the CBS and our demand database, and summed these. All freight that changed from road to rail or water was required to have 15 kilometers of pre- or post- mode road transport added to its costs. The size of each multimodal center was estimated from data on the amount of containerized freight passing through each node and the calculated modal split for the appropriate region of the country.

Investment costs of the terminals were developed from data for the existing multimodal centers in the country. Our estimate of modal shift is probably closer to an upper bound than otherwise, because of the uncertainty of the real elasticities of transport and the actual transfer times at nodes without multimodal terminals. Our cost estimates are probably reasonable, having been based on reported cost data.
Tactic 3.01-Improve Internal Logistics In Rotterdam

Because the tactics are similar, we included Tactics 3.15 “Differentiate Sea Transport and Inland Waterways in Ports” and 3.17 “Use Regional Dispatching Systems in Ports” in the specifications of this tactic. Most of these tactics have as their main goal the reduction of waiting times for containerized freight being forwarded by inland shipping from the Port of Rotterdam. In our analysis, we estimated the waiting time reductions for inland shipping companies that might result from these changes to the system. We then compared the reductions to the total transport costs for inland shipping containers that pass through Rotterdam. The three primary actions are (1) announcement of truck arrivals at terminals, (2) announcement of ship arrivals at terminals, and (3) use of a floating container terminal (with an assumed cost of Dfl 10 million). We obtained information from the CBS and other sources about the number of containers shipped through Rotterdam and the average number of containers per inland ship and truck (150 and 1.4 respectively). We calculated the value of time savings from a Dutch study of the average delay time reduction per truck and ship, using an assumed value of Dfl 0.412 per hour per ton (including the value of the inland ship and crew). This estimate is probably neither an upper nor lower bound, but rather a reasonable estimate given the uncertainty in the analysis.

Transhipment of containers from one terminal to another results in about 200,000 movements by truck per year (an average of 20 kilometers and 12 minutes per move). We did not include tactics that reduce the truck times and distances, because they produce only small savings and would have the perverse effect (from this project’s point of view) of reducing the cost of truck transport, thereby increasing the amount of freight being transported by truck.

Tactic 3.08-Build More Waterways

This tactic would expand the inland waterway network by building sufficient waterways to increase the density to that of the road network. This action, combined with improvements to other waterways to make them accessible to larger ships would increase the attractiveness of inland shipping to freight traffic. In the analysis, we added the links needed to make the PACE-FORWARD waterway network as dense as the roadway network. We assumed that each new link of the waterway network had the same length as the corresponding link of the road network. The investment cost was calculated assuming an average cost of Dfl 9.2 million per kilometer (taken from the Trendbreuk Study). We calculated the amount of freight shifted from road to water by link based on the existing or expected road freight transport by link (from the demand data base) and a mode shift of 19.5 percent. This represents the average current regional split between road and rail in The Netherlands. For all shifted freight we assumed a total of 15 kilometers of road transport before or after its waterway transport, the costs of which were determined using our standard procedure.

Tactic 3.10-Cancel the System of Equal Distribution of Cargo for Shipping

The existing system of equal distribution gives a chance to each shipper to transport freight for a fixed price. This guarantees a basic income for the shippers, but makes it impossible for forwarders to know in advance who will be transporting their freight. By canceling the system, forwarders would get to choose their transporter, which would make waterway transport more attractive. However, this tactic is expected to result in only a very small mode shift. Therefore, it was screened out before modeling.
Tactic 3.11- Use Stackable Swap Bodies And Design Ships For This Kind Of Transport

Only road and rail use swap bodies. Designing ships for this kind of transport increases efficiency and the compatibility between road, rail, and water. We did not model this tactic because of a lack of information.

Tactic 3.18-Reduce The Number Of Empty Ship Trips

Data and analysis indicate that there are large numbers of empty trips made by ships traveling on links of the PACE-FORWARD network. If there were better communication among shippers and better information about where cargoes were available, it might be possible to reduce the number of empty trips. Our specification of this tactic provides an upper bound on the emission benefits that could result from such a reduction. We determined the number of full and empty trips by PACE-FORWARD network link from results produced by a NEA model of shipping operations. To apply the tactic, we assumed for every link, that if there are empty trips in opposite directions by the same category of ship, we could match two full shipments and eliminate an empty round trip. We provided this information to the model in terms of either: an increase in the fraction of kilometers traveled by full ships, or an increase in the fraction of ton-kilometers traveled by full ships. This results in an upper bound because (1) empty trips may occur at different times, (2) ultimate origins and destinations may be different, and (3) the information and communication systems do not currently facilitate this type of activity.

Tactic 3.32-Provide Free Transport Of Goods By Water

To specify this tactic, we assumed that forwarders would not pay for transporting their goods by inland waterway, although they would still have to pay for road transport both before and after the waterway transport. For this transport (as with all our analysis) we used the cost coefficients developed by Knight Wendling, the transport travel time data from NEI, and the pre- and post- waterway transport distances assumed in the Trendbreuk Study (7.5 kilometers at each end). We also assumed that all extra delay associated with the transport would cost 0.168 Dfl/ton/hour. We applied the tactic to all freight traveling more than 200 kilometers using CB data for the distribution of freight transport between bulk and containerized cargo. By reducing waterway transport costs, this tactic encourages a shift of cargo from road to shipping, but does not eliminate all costs of waterway transport. Although this tactic generates a large mode shift, the analysis has three important limitations. First, the waterway transport is only free to the forwarders—someone (presumably the government) must pay for it. In the model, this cost does not automatically appear because it is not a net increase in costs, only a transfer payment. Second, this is clearly an upper bound because we did not distinguish freight by type of commodity, and there are factors other than cost that enter transport decisions. Finally, we did not have sufficient data to evaluate whether or not the waterway system could accommodate this mode shift. In particular, we could not determine if additional inland ships would be required by the shift of freight from road and rail to water.

Tactic 4.01-Expand The Competition With Dutch Railways

Currently the NS has a monopoly on service. Competition often lowers prices, improves service, and leads to more efficient use of resources. Unfortunately, we do not know how to estimate these effects if the NS were to have expanded competition. To specify this tactic we therefore assumed as a default condition that competition would improve service and lower prices to produce the effect of a 10 percent reduction in costs. This tactic has no additional costs associated with it, because we have not specified how the competition might be expanded. To the extent that there will be costs and service improvements that do not reach our assumed nominal value, the results of this tactic will be an upper bound.
Note that the analyst can specify the percentage of rail cost reduction caused by the tactic in order to investigate parametrically how reduced investment would affect modal shift. Note also that we have not incorporated any effect of potentially reduced revenues for the NS or rail industry.

**Tactic 4.02—Expand The Infrastructure For Rail**

Increasing the density of rail infrastructure will increase accessibility and the attractiveness of rail over road, causing some modal shift. In this tactic we added electric rail capability for the missing links identified in the Trendbreuk Study. From that study we identified links that corresponded to five links of the PACE-FORWARD rail network and which required 410 kilometers of new rail. We assumed this would be built at a cost of Dfl 37.5 million per kilometer (the average of single and double track electric rail from the Trendbreuk Study). To calculate the potential mode shift from road to rail on the new links, we multiplied the road freight transport by network link (determined from the demand database) by the average ratio of rail to road transport across the nation. For national transport this is 0.13; for international transport it is 0.15, both determined from CBS data. We also assumed that all shifted freight would still require 7.5 kilometers of road transport at each end of the rail segment. In this analysis we did not include the costs of any new rail transport infrastructure or rail cars and engines. To the extent the current infrastructure is insufficient, the costs will be underestimated. Moreover, our assumed mode shifts should be considered a best guess, which might be either high or low, depending on the extent to which the additional track improves the attractiveness of the entire network for rail transport.

**Tactic 4.04—Build New Railroad Spurs**

New rail spurs would increase the number of businesses and industry that could easily ship freight using the railroads. This tactic applies to both national and international freight. To calculate the potential shift of goods from road to rail, we multiplied the road freight transport by PACE-FORWARD network link (for those links having rail segments) by the current maximum ratio of rail to road freight for the network (0.121 from CBS data). For international transport we used an estimate of 0.25, which falls about in the middle of the range of modal split values for the different regions with good rail connections. We assumed that the spurs would replace road transport before and after the rail links. The cost calculations used a cost of Dfl 5 million per kilometer for spurs and an average length of 7.5 kilometers. We determined the required number of spurs by dividing the number of tons of freight shifted by the average number of tons shipped per company in the Netherlands, separating national from international freight. We multiplied this result by a factor of 2/3 to account for the opposing effects of spur use by more than one company and division of freight transport between road and rail by other companies.

**Tactic 4.05—Speed The Exchange Between Road And Rail**

Based on the effects of some of the Rotterdam Internal Logistics tactics, we assumed that the exchange of cargo between road and rail could be speeded up by an average of 2 hours per trip. Using this information, we calculated how much total transport time would be reduced for rail transport trips of more than 100 kilometers. Transport and transfer times for this analysis were calculated using the procedures and data developed by NSI for the Trendbreuk Study. We used these values with the relative value of travel time taken from a study performed by the Hague Consulting Group to estimate the resulting equivalent reduction in transportation costs for each length trip. Assuming a reasonable distribution of trip lengths, we calculated an average equivalent reduction in rail cost for input to the elasticity model. This result should be a reasonable estimate.
rather than an upper or lower bound, but we do not know how much improvement may be possible in the transfer process. Moreover, we have not estimated any costs for making this improvement, because a method of implementation was not specified.

**Tactic 4.06—Provide Free Transport Of Goods By Rail**

To specify this tactic, we assumed that forwarders would not pay for transporting their goods by rail. They would still have to pay for road transport both before and after the rail transport. For this transport (as with all our analysis) we used the cost coefficients developed by Knight Wendling, the transport travel time data from NEI, and the pre- and post-rail transport distances assumed in the Trendbreuk Study (7.5 kilometers at each end). We also assumed that all extra delay associated with rail transport would cost 0.168 DM/ton/hour. We applied the tactic to all freight traveling more than 100 kilometers, using CBS data for the distribution of freight transport between bulk and containerized cargo. This approach reduces rail transport costs, thereby encouraging a shift of cargo from road to rail, but would not eliminate all costs of rail transport.

Although this tactic generates a large mode shift, three things must be remembered. First, the rail transport is only free to the forwarders—someone (presumably the government) must pay for this transport. In the model this cost does not automatically appear because it is not a net increase in costs, only a transfer payment. Second, this is clearly an upper bound, because we did not distinguish freight by type of commodity, and there will be factors other than cost entering transport decisions. Finally, we did not have sufficient data to evaluate whether or not the rail system could accommodate this mode shift. In particular, we could not determine if additional engines or rail cars would be required or how much disruption of passenger service might be implied by the shift of freight from road and water to rail.

**Tactic 4.10—Reduce Time Trains Spend At International Borders**

It currently takes from 30 to 60 minutes to change locomotives at borders between countries. In this tactic, we assumed that you could reduce this time to zero (in the long run) by improving international cooperation of railway companies. In order to get an upper bound on this effect, we assumed that the current exchange time was 60 minutes. Using this information, we calculated how total transport time would be reduced for rail transport trips of more than 100 kilometers. Transport and transfer times for this analysis were calculated using the procedures and data developed by NEI for the Trendbreuk Study. We used these values with the relative value of travel time taken from the study performed by the Hague Consulting Group to estimate the resulting equivalent reduction in transportation costs for each length trip. Assuming a reasonable distribution of trip lengths, we calculated an average equivalent reduction in rail cost for input to the elasticity model. This result should be an upper bound because we do not know how much improvement may be possible. Moreover, we did not include a cost for making this improvement, because a method of implementation was not specified and because implementation will require long-term changes in international railroad transport procedures and systems.

**Tactic 4.12—Improve Existing Rail Infrastructure**

Improve the infrastructure to increase safety and speed. Tactic 4.14 shows the upper bound concerning the increase in speed. The safety aspect fell outside the scope of this project.

**Tactic 4.14—Introduce Fast Freight Trains**

This tactic would use high speed trains to carry international freight. Feasibility studies have indicated that only trucked air freight
may be suitable and relevant for analysis in the FORWARD project. Accordingly, we considered only the use of freight cars on the Train Grande Vitesse (TGV) to transport cargo from Amsterdam to Paris. Constraints limit the suitable freight to 1,500 tons per year in small packages which, can be shipped at an average cost of Dfl 15.7 per ton-kilometer averaged over the 140 kilometers within The Netherlands. This shift of 210,000 tonne-kilometers from road to rail is probably a lower bound because of the assumptions made in the analysis. More freight could be carried on additional trains in the future, particularly when more routes are added and if freight transport were given higher priority on the fast trains.

**Tactic 5.01-Increase The Excise Duty On Diesel Fuel To Include Environmental Costs**

This tactic would impose a tax on diesel fuel to raise its price to compensate properly for the environmental costs of transportation in terms of air pollutant emissions, noise, accidents, maintenance and repair costs, and congestion. The revenues from the tax would be used to fund environmental and health research or to repair and maintain the infrastructure. The amount of the tax was taken from the report *Getting the Prices Right: A European Scheme for Making Transport Pay its True Costs*, written by the European Federation for Transport and Environment. To obtain the tax increase, we subtracted the current tax on diesel fuel from the tax level recommended in the reference.

**Tactic 5.02-Increase Motor Vehicle Tax To Account For Environmental Impact**

This tactic is similar to tactic 5.01 "Increase Excise Duty of Diesel Fuel to Include Environmental Costs." In this case, we change the tax from one on diesel fuel to one on all trucks, no matter how they are powered. The tax was calculated from the basic rate per thousand tonne-kilometers specified in *Getting the Prices Right*. We apportioned the total tax by truck type based on the total annual fuel consumption of each truck type, then divided this by the number of trucks of each type. A separate tax was calculated for each scenario. In the analysis, the PACE-FORWARD model calculates the total tax on trucks for a scenario, then determines the ratio of this tax to the total road transport cost. This fraction is used as the relative change in road transport costs for input to the modal shift model.

**Tactic 5.04-Introduce Tolls On Roads**

This tactic would introduce a toll on road freight to increase the cost of road transport and reduce the attractiveness of roads compared to rail and inland waterways. Also, the toll would recover some of the external costs of road freight transport. To specify the tactic, we required that all trucks pay a toll of Dfl 0.2 per kilometer for all freight transport on highways. We calculated the total kilometers per year by truck type as well as the fraction of these kilometers that would be traveled on toll roads (assumed to be all highways outside cities), using data taken from the CBS. For future scenarios, we calculated annual tolls by truck type by scaling the tolls for the current year by the total ton-kilometers in future scenarios. In the analysis, the PACE-FORWARD model calculates the total toll on trucks for a scenario, then determines the ratio of this toll to the total road transport cost. This fraction is used as the relative change in road transport costs for input to the modal shift model.

**Tactic 6.01-Enlarge Size And Weight Of Trucks**

This tactic would encourage transporters to use larger trucks if possible, as described in the Trendbreuk study for national road freight. International road freight would continue to be carried in trucks of type III. We based the effects of the tactic on the Trendbreuk study result for "bigger trucks," assuming no additional waiting or searching for cargo.
These effects were modeled by increasing the average utilization (product of loaded fraction and loaded trip fraction) for all trucks by a factor of 1.055 for national transport. This factor was determined by dividing the Trendbreuk study index for total freight transported by the index for total kilometers traveled (in national transport). This result assumes that the increase will be the same for all trucks and that the relative shares of road transport by trucks of different sizes will not change. The cost of this tactic was determined from the additional hours of transport associated with longer loading, unloading, and travel times. These 5.0 hours of delay were evaluated from the Trendbreuk data and priced at our standard 0.168 Dfl/ton/hour of delay.

**Tactic 6.011-Permit Heavier Trucks In The European Union**

For this tactic, we assumed that the EU would allow international transport to be carried in the 50-ton trucks that are now used in the Netherlands. We assumed that this tactic would have no cost, because such trucks would not be required, only permitted. As a result, transporters would either use their existing trucks outside the Netherlands or would purchase larger trucks when they would normally replace or supplement their fleets. In either case, there should be no tactic cost, since all decisions would be purely voluntary and economic. We implemented this tactic in the model by increasing the size of the type III trucks used for international transport to match that of trucks used for national transport. Although this tactic might have effects on noise, congestion, safety, and road damage, we think they would be small and we had no information from which to estimate them.

**Tactic 6.02-Increase Load Factors For Trucks**

The specification of this tactic was based on the results of the Trendbreuk Study analysis for “fuller” trucks. We assumed that trucks would not be increased in size or weight, but would wait and search for freight to transport, thereby increasing the average utilization factor (product of loaded fraction and loaded trip fraction) for all trucks by a factor of 2.54 for national transport and 1.46 for international transport. These factors are clearly upper bounds and were determined by dividing the Trendbreuk study indices for total freight transported by the indices for total kilometers traveled (for national and international transport taken separately).

These results assume that the increases will be the same for all trucks and that the relative shares of road transport by trucks of different sizes will not change. We assumed (as did the Trendbreuk Study) that in 2015 all international transport will take place in type III trucks and that the relative changes in the number of loaded trips will also hold for the number of empty trips. The cost of this tactic was determined from the additional hours of transport associated with longer loading and unloading times and more waiting for freight. These hours of delay (5.6 for national transport and 8.4 for international) were evaluated from the Trendbreuk data and priced at our standard 0.168 Dfl/ton/hour of delay.

**Tactic 6.041-Use Of Telematics By Transporters**

In specifying this tactic we made the assumption that the average utilization factors of all trucks would be increased by the maximum amount predicted by Tactic 6.02 “Increase Load Factors for Trucks,” i.e., the Trendbreuk results for “fuller” trucks. This clearly produces an upper bound for the tactic, because to accomplish this improvement we assumed that trucks would use telematics instead of waiting and searching for freight. Because much of the delay time is associated with loading and unloading activities as well as transport, there would still be delays (at 0.168 Dfl/ton/hour) of 5.2 hours for national and 8.1 hours for international freight. The cost analysis assumed that all truck transport companies (7,547 according to our references) would acquire either
telephone or mobile satellite communications systems. The total costs of these systems would be similar—about Dfl 260 million for investment and Dfl 57 million per year for operation.

**Tactic 6.042—Use Telematics For Combined Transport**

The use of telematics and/or electronic data transfer could speed up different phases of the transport system and improve coordination. This tactic focuses on the use of telecommunications at current combined transport facilities. Improved communication would reduce transfer times, making rail and waterway transport more attractive. We did not take the existing capacity of these facilities into account. We estimated the costs for two components of the system. First, we determined the costs of supplying all truck transport companies with communications systems as in Tactic 6.041 "Use of Telematics by Transporters." Second, we estimated the costs of supplying all combined transport centers with terminal systems.

Because this tactic is separate from Tactic 6.041, only the communications between these centers and the trucks needed to be counted toward the operating cost of this tactic. We estimated the mode shift for this tactic from the relative reduction in total transport time by mode and affected link for freight passing through combined transport centers. Improved communication would reduce the transfer time for cargo, which could be converted into a relative reduction in transport cost using the methodology of the Hague Consulting Group. The reduction could then be translated into modal shifts between road, rail, and water. These calculated modal shifts, which move goods from road and rail to water, are a best estimate and may be either higher or lower than what would actually occur.

**Tactic 6.08—Equalize The Rights and Duties Of Transport On Own Account And Professional Account**

Currently transporters on own account may not transport anyone else’s goods. Giving them the right to transport other goods would bring the empty trip and load utilization factors to the levels for transport on professional account. We specified this tactic in that way—applying the percentages for professional transport to all trucks involved in transport on own account. This tactic applies to national transport only, and will generally produce an upper bound. Because professional-account transporters would be competing with own-account transporters for cargo, the utilization rates of both would probably approach some value between the current values of each. However, the competition should make both segments more productive, so the assumption may not be too much of an upper bound.

**Tactic 7.02—Use Speed Limiters On Trucks**

This tactic would require all trucks (other than vans) to have speed limiters to reduce highway speeds and accident rates while improving fuel efficiency and emission rates. We took our costs and effects from an RIVM study of speed limiters. They assumed that new trucks would have speed limiters by 1997 and existing trucks by 1999. These would limit their maximum speeds to 80 kph. The investment cost of the equipment would be Dfl 1,950 per truck, but savings in maintenance and tire wear of Dfl 600 per year should be possible. There would also be net reductions in fuel consumption and noise production, which are calculated by FACE-FORWARD as a result of the reduced highway speed. Because trucks would be traveling more slowly and at more uniform velocities, we estimated that accident frequency would be reduced by about 3.4 percent.

**Tactic 7.04—Use Separate Lanes For Trucks**

This tactic would create separate lanes for trucks on highways, bridges, tunnels, and other dangerous areas to keep them away from other
vehicles in traffic. We assumed that these lanes would be taken from existing multi-vehicle lanes, rather than added to the existing highways. Consequently we did not calculate any cost for this tactic.

Separating automobiles and trucks would significantly reduce accident rates. As an upper bound, we assumed a 12 percent reduction in accident frequencies for trucks. This will clearly be an upper bound because separate lanes would be used only in certain areas, not everywhere in the country. Similarly, by removing existing lanes to dedicate them to truck use, this tactic would improve congestion for trucks but make it worse for other vehicles wherever it is implemented.

**Tactic 9.01-Compel Trucks To Drive At Night**

This tactic would reduce congestion on highways during the day by forcing trucks to travel at night. Note that it directly contradicts Tactic 8.02 “Forbid Trucks to Drive at Night,” which is designed to reduce noise generation. We combined this tactic with Tactic 9.04 “Open Ports at Night” and 9.05 “Compel Factories and Forwarders to Remain Open at Night” because trucks deliver at night unless ports, factories, and forwarders are also open at appropriate times. We did not attempt to predict enforcement costs or the additional costs to businesses of maintaining nighttime operations to facilitate truck transport. To analyze this tactic, we assumed that the displaced truck traffic would be distributed uniformly over the nighttime hours. Accordingly, this would cause an average delay of eight hours for goods normally shipped during the day. This delay was evaluated at 0.168 Dfl per ton per hour. Because trucks would interact less with automobiles during the day, accident rates would be reduced as would daytime congestion. Daytime noise would be reduced, but nighttime noise would increase significantly. The costs of the tactic would probably be higher than those calculated in the model, depending on the incremental costs to businesses, ports, and transporters to adjust their operating hours to accommodate nighttime transport operations.

**Tactic 10.02-Expand Distribution Centers Within Towns**

In specifying this tactic, we assumed that all Dutch cities with populations greater than 59,000 (48 cities with average population of 130,000) would build city distribution centers (CDCs). These centers would be located at the edge of towns and would receive freight by truck to subsequently distribute it to stores by van. Our estimates of the costs and effects of this tactic were based on a study by Coopers and Lybrand of a typical distribution center serving a city of 130,000. The report says that each center would cost an average of Dfl 17 million to build. Using the centers to transfer suitable freight (3,000 shipments/day) should lead to a reduction of 21,426 kilometers per day (operating only on weekdays) of travel within each city by type II trucks.

The delivery vans would travel more fully loaded and should only require 2,426 kilometers per day of additional travel in each city. Total operating costs should be reduced by Dfl 4.9 million/year for each city including the cost of freight unloading, transfer, and loading. Because this type of center did not work well when implemented as a single CDC in Maastricht, we decided that an entire network of centers is necessary and that certain regulations or procedures will need to be established to ensure that the centers function as designed. Given these conditions, the effects of this tactic will probably be an upper bound, but not necessarily a high upper bound.

**Tactic 11.021-Make Better Use Of Existing Pipelines**

To specify this tactic we assumed that industry would use pipelines instead of road transport on all links where pipelines already exist and have unused capacity. This transport would be limited to suitable liquid cargo. Because the only pipelines having excess capacity are petroleum
pipelines, only petroleum products could be shifted to pipelines. We also assumed that licensing would not cost extra, that there were no physical planning problems, and that materials could be sent in only one direction through the pipeline, the direction shown by the link nomenclature. Because freight quantities would be small, and no pipelines are to be constructed, we have assumed that all shifted petroleum products would require 7.5 kilometers of road transport before and after the pipeline transport. The energy cost (Dfl 0.0076 per ton-kilometer) and emission rates (assuming electric pumps) were taken from the literature. This tactic includes both national and international transport. The results should be considered an upper bound on both costs and effects, because there will be other constraints on pipeline transport of existing goods. This tactic can obviously be implemented partially, where suitable freight flows and pipelines are available.

Tactic 11.022-Expand Network Of Pipelines To Shift Freight From Road To Pipelines

This tactic would use pipelines instead of road transport for suitable liquid cargo. Rather than using excess capacity on existing pipelines, this tactic would require constructing pipelines on available routes to meet the transport demands. Suitable materials would include not only goods that are currently transported by pipeline either in The Netherlands or elsewhere, but also goods that might be transported by pipeline. We only considered freight currently transported by road, and limited pipelines to routes on which they would carry at least 100,000 tons per year of one commodity category in one direction. Because freight quantities would be large, we have assumed that spurs (equal to 10 percent of the pipeline length) would be constructed to eliminate any road transport for shifted freight. Pipelines were assumed to cost Dfl 400,000 per kilometer to construct and Dfl 8,500 per kilometer per year to maintain. Both of these are average values in large cost ranges. The energy cost (Dfl 0.0076 per ton-kilometer) and emission rates (assuming electric pumps) were taken from the literature. This tactic includes both national and international transport. The results should be considered an upper bound on both costs and effects, because there will be other constraints on pipeline construction and transport. This tactic can obviously be implemented partially where suitable freight flows and pipeline routes are available.

Tactic 11.032-Use Moving Sidewalks To Transport Containers Internationally From Rotterdam

To reduce international container transport by road, this tactic would replace all road transport of containers between Rotterdam and Duisburg and between Rotterdam and Antwerp by transport on moving sidewalks. The construction of such a moving sidewalk using electric vehicles has not yet been attempted, but plans exist for a two kilometer experimental system using electric trucks within the Maasvlakte. We used this type of system as the basis for our cost and effectiveness estimates for the tactic. The investment cost for the infrastructure (assuming transport in both directions) would be Dfl 15 million per kilometer plus Dfl 200,000 per vehicle. We assumed from the literature that the system would require 750 vehicles for every 50 kilometers of roadway. The total distance in The Netherlands for the two routes would be 175 kilometers. The operating costs of the vehicles were assumed to be the same as those of normal trucks. Because the vehicles would be electrically driven, the emission rates were estimated from data for electric rail and electric van transport.

Tactic 11.05-Use Short Sea Transport Between Ports

This tactic would use short sea transport instead of road transport for international containers when the costs of short sea were at least 35
percent lower than the costs of road transport. From the demand database and CBS data we determined that three destinations may meet the criteria for transport to and from Rotterdam in the current scenario: (1) other Western Europe (444,000 tons), (2) Portugal (689,000 tons), and (3) Greece (303,000 tons). For other demand scenarios we inflated these freight quantities by the overall growth in demand by road for the above three regions. We also assumed that all freight would still require 15 kilometers of road transport at one end of the trip or the other. Although the PACE-FORWARD model only calculates transport costs within The Netherlands, for this tactic we calculated total costs by both modes and subtracted the entire difference in transport cost from the cost calculated by the model.
APPENDIX E

PACE-FORWARD RESULTS

This appendix contains the PACE-FORWARD output for each of the 27 DGV project clusters that are listed in Appendix B and for the three promising FORWARD tactics that are not represented by any of the DGV projects, which are described in Appendix C.

The output is in the form of a matrix. The rows of the matrix are the 30 FORWARD tactics that were evaluated in this study. (Results for the three suggested additional projects mentioned in Appendix C are given in bold.) The columns are the estimated impacts of the tactics. The base case for estimating impacts is given by the situation (freight demands, amounts being transported by mode) in the European Renaissance scenario for the year 2015, with no tactics besides the Betuwelijn implemented. These estimated impacts are all upper bounds on what might be expected from the implementation of the tactics.

The columns contain the following information:

Column 1: FORWARD tactic identification number and name. (A description of each of these tactics can be found in Appendix D.)

Column 2: The percentage change in the number of tonnes of freight carried on the Betuwelijn, compared to the base case. (The base case assumes that the Betuwelijn carries all freight that is transported by rail between Rotterdam and Germany (through Arnhem) in the 2015 European Renaissance scenario.)

Column 3: The percentage change in the share of freight (tonne kilometers) that is transported by non-road modes.

Column 4: The percentage change in truck kilometers.

Column 5: The percentage reduction in road freight emissions of NOx.

Column 6: The percentage reduction in road freight emissions of CO2.

Column 7: The percentage reduction in the road congestion measure.

Column 8: The percentage change in value added and employment in the transport sector.

Column 9: The percentage change in value added for the economy as a whole.

-E.1-
There are no results shown for three of the FORWARD tactics (tactics 3.10, 3.11, and 4.12). These tactics were not implemented in the PACE-FORWARD model. An explanation of why they were not modeled is given in App. D.
<table>
<thead>
<tr>
<th>FORWARD Tactic</th>
<th>Change in Betuwelijn Tonnes as % of baseline</th>
<th>Change in non-road modes as % of baseline (by Tkm)</th>
<th>Change in truck kilometers as % of baseline</th>
<th>NOx: % reduction w.r.t. baseline from road freight transport</th>
<th>CO₂: % reduction w.r.t. baseline from road freight transport</th>
<th>Congestion: % reduction w.r.t. baseline from all road traffic</th>
<th>Value Added/Empl. for economy as a whole: % change w.r.t. baseline</th>
<th>Value Added for economy as a whole: % change w.r.t. baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.02 Settle appropriate (new) firms at water and rail</td>
<td>31%</td>
<td>15%</td>
<td>-13%</td>
<td>15%</td>
<td>3%</td>
<td>-7%</td>
<td>-6%</td>
<td>-6%</td>
</tr>
<tr>
<td>2.06 Create multi-modal centres</td>
<td>181%</td>
<td>6%</td>
<td>-7%</td>
<td>7%</td>
<td>2%</td>
<td>-1%</td>
<td>-1%</td>
<td>-1%</td>
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<td>3.01 Improve internal logistics in Rotterdam</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
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<tr>
<td>3.03 Use faster ships</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
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<td>0%</td>
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<tr>
<td>3.08 Build more waterways</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
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<tr>
<td>3.10 Cancel the system of equal distribution of cargo for shipping</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
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<td>0%</td>
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<tr>
<td>3.11 Use stackable swap bodies and design ships for the kind of transport</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
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<td>3.18 Reduce number of empty ship trips</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
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<td>3.32 Provide free transport of goods by water</td>
<td>-72%</td>
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<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>-3%</td>
<td>-1%</td>
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<td>4.01 Expand the competition with Dutch Railways (NS)</td>
<td>27%</td>
<td>1%</td>
<td>-1%</td>
<td>1%</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
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<td>4.02 Expand the infrastructure for rail</td>
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<td>6%</td>
<td>-6%</td>
<td>6%</td>
<td>6%</td>
<td>1%</td>
<td>-3%</td>
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<tr>
<td>4.04 Build new spurs</td>
<td>200%</td>
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<td>20%</td>
<td>4%</td>
<td>-11%</td>
<td>-7%</td>
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<tr>
<td>4.05 Speed up the exchange between road and rail</td>
<td>25%</td>
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<tr>
<td>4.06 Free rail goods transport</td>
<td>161%</td>
<td>3%</td>
<td>-3%</td>
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<td>1%</td>
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<tr>
<td>4.10 International cooperation among railway companies</td>
<td>13%</td>
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<td>4.12 Improve existing rail infrastructure</td>
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<td>4.14 Introduce fast freight trains</td>
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<tr>
<td>5.01 Increase excise duty on diesel fuel to include environmental costs</td>
<td>6%</td>
<td>1%</td>
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<td>1%</td>
<td>1%</td>
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<tr>
<td>5.01b Increase diesel tax by drill 3.00/liter for environmental costs</td>
<td>26%</td>
<td>3%</td>
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<tr>
<td>6.01 Enlarge sizes and weights of trucks</td>
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<td>6.011 Permit Heavier trucks</td>
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<td>19%</td>
<td>18%</td>
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<td>6.02 Require a minimum load factor of trucks</td>
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<td>6.04 Use telematics by transportans</td>
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<td>43%</td>
<td>44%</td>
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<tr>
<td>6.042 Use telematics for combined transport</td>
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<tr>
<td>6.08 Equalize the rights and duties of transport on own account and professional account</td>
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<td>5%</td>
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<td>7.02 Use speed limiters</td>
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<td>7.04 Use separate lanes for trucks</td>
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<td>9.01 Compel train at night</td>
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<td>10.02 Expand distribution centres within towns</td>
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<td>11.025 Expand pipelines (comb. of 11.021&amp;11.022)</td>
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<td>11.032 Use moving sidewalks for containers internationally from Rotterdam</td>
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REFERENCES


