

# True Value – case study Apeldoorn & Doetinchem-Wesel

## About the document

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## Introduction

In our [integrated annual report 2016](#), we presented the outcome of our first step in monetising our non-financial impact to provide insight into a project's true societal impact. We took our project in Apeldoorn as case study. In our [integrated annual report 2017](#), we took the next step in monetizing our impact and used our project Doetinchem-Wesel as case study.

Although difficult, we see the value in being able to compare the different impact we have.

In this document the used method, results, uncertainties and used conversion factors are explained in some more detail.

## Method

In 2016, TenneT participated in a business breakthrough program of "de Groene Zaak" and "het Groene Brein" in 2016. This program supports companies to work on their 'Value creation' by offering support and knowledge from a coalition of facilitators; De Groene Zaak, Het Groene Brein, TruePrice, EY, KPMG and various scientists. For period of one year we worked together with the facilitators to determine our methodology and discuss our results.

Our results were achieved by using the following step-by-step approach:

1. Determine clear objective
2. Collect information
3. Perform detailed assessment of the value chain for the old and new situation
4. Analyze impact
5. Define clear scope
6. Calculate impact and convert to euro's
7. Publish and share results

In our calculations we focused on the impact for society and society is defined as "the Netherlands". The impacts are calculated by looking at the impact of the new situation minus the impact of the old situation. The total impact is calculated for a period of 40 years.

## Case study Apeldoorn

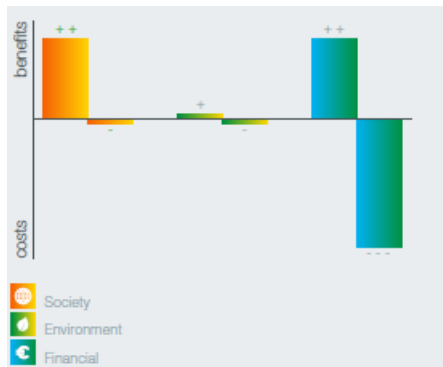
In the selected pilot project in Apeldoorn, we installed underground cabling in the municipality to replace an overhead line that crossed two neighbourhoods and a park. All the steps in the cabling value chain were taken into account, i.e. raw material extraction and production, the removal of existing lines and cabling, the operation of the high-voltage connection and end of life.





## Results

The results of our research show that the improvement of the living environment had by far the most impact on social value, as illustrated in the chart below. For the ecological impact, carbon footprint, material depletion and biodiversity were taken into account. Since the surroundings did not change significantly, effects on biodiversity were minor. Financial costs consist of investment and maintenance costs, while the financial benefits relate to lower operational costs and increased value for the area around the high-voltage connection.



## Society

Safety, construction nuisance, living environment and grid availability were part of the scope of society. Out of scope was employment due to the small number of employees working on this project.

- Safety  
Safety incidents during the construction phase would have a direct impact. However, there were no incidents reported and therefore there is no safety impact.
- Construction nuisance  
The residents of Apeldoorn-Zuid experienced the house accessibility as most obstructive. We took the additional travel time due to the construction work into account.
- Living environment  
The living environment, how a person feels about a certain area, is affected by the presence of the steel pylons and overhead lines. To value the removal of the steel pylons and overhead lines an inverse calculation is performed by reversing the value drop by building new high electricity lines.
- Grid availability  
Reconstruction projects like the cabling project in Apeldoorn-Zuid are not performed to improve the grid availability. There is no change in redundancy, therefore the effect on grid availability is assumed non-existing.

## Environment

Material depletion, biodiversity and carbon emissions have been analysed and measured. Other ecological effects like water pollution, waste production, land use were not in scope.



- **Material depletion**  
Only the value of the used aluminium is taken into account, because this is one of the major components in cables.
- **Biodiversity**  
During the project trees and shrubs have been removed or relocated to be able to lay the cables or remove the steel pylons. The type of nature has not been changed. Assumptions have been made for new planted trees and shrubs. The calculated impact is not at all significant. We left underground biodiversity out of scope.
- **Carbon emissions**  
To calculate the carbon emissions we estimated and/or calculated the emissions related to; production materials, travel in the construction phase, use of machines during the construction phase and grid losses during the operation phase. Grid losses, since they occur during 40 years of operation, have most impact.

## Financial

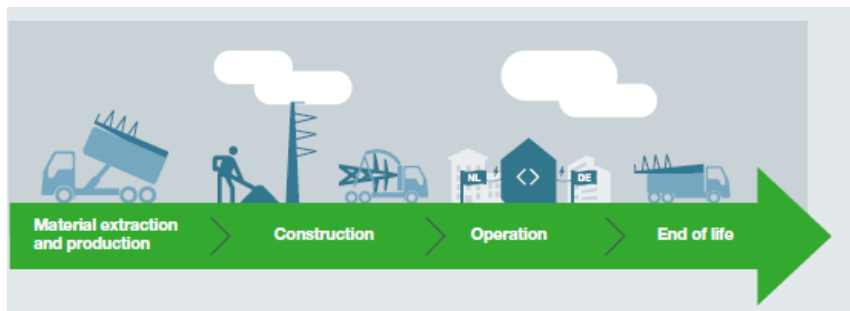
Investment costs, maintenance costs, operational costs and value of the ground have been taken into account. The WOZ ("waardering onroerende zaken") value which tax income municipality would gain or lose after re-valuing the house prices, has not been taken into account, since this would be shifting money from citizens to municipality and therefore there is no impact for the Netherlands as a whole.

- **Investment costs**  
The investment costs are related only to the costs for purchase of materials and the construction work concerning the cables. At the same time the sewer was also replaced, but these costs are out of scope.
- **Maintenance costs**  
All activities related to maintenance, from visual inspection to actual repair activities have been taken into account.
- **Operational costs**  
A large part of the operational costs relate to grid losses. Therefore we focused on these costs and did not include other operational costs.
- **Value of the ground**  
According to law it is not allowed to build any houses or public buildings below existing high electricity lines. Therefore the ground underneath the existing lines could not be sold as construction ground. Having a cable instead of a line changes this situation and increases the value of the ground.

## Case study Doetinchem-Wesel

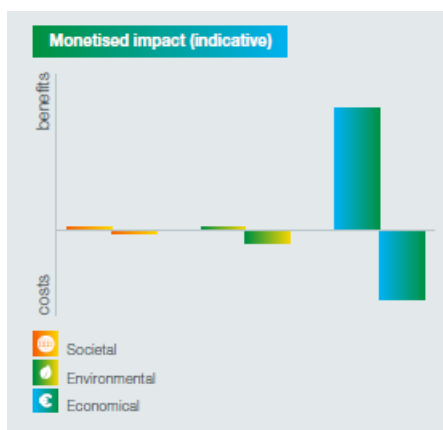
The new interconnector between Doetinchem in the Netherlands and Wesel in Germany is essential to ensure the continued development of the North West European electricity market, to safeguard security of supply and to be able to exchange sustainable electricity. Construction started in 2015 and the interconnector is expected to be fully operational by late 2018. When completed, the interconnector will be 57 kilometres long and will have a physical transport capacity of 1,500 MW. To achieve this, we have installed 108 Wintrack pylons and carried out other construction in the region for over two years. For this case study, we focussed on the Dutch part of the new interconnector and the

impact of the project on Dutch society compared to a situation with no new interconnector. The case study considered all the steps in the value chain, i.e. raw material extraction and production, the construction phase, the operation of the high-voltage connection and end of life.



## Results

The results of the case study show that the economical impact is by far most significant. The economic impact includes the employment generated by the construction and operation of this interconnector, the price benefit of this interconnector when it is in operation and the investment costs, which have a negative economical impact for society. The societal impact is minimal, because the impact of the connection on the living environment can be seen as neutral, since the new connection is replacing an existing connection. For the environmental impact, carbon footprint, material depletion and biodiversity were taken into account. Although the carbon emissions and material depletion have some impact, this is minimal compared to the economical impact.



## Societal

Safety, construction nuisance, education, living environment and grid availability were part of the scope of societal costs.

- Safety  
Safety incidents during the construction phase have a direct impact. The impact of three incidents that occurred are taken into account.
- Construction nuisance  
The residents of some municipalities near the construction sites had extra travel time due to the construction activities. Land owners had to allow construction activities on their land. The impact of both nuisances have been taken into account.



- **Education**  
During the construction activities there was a dedicated visitor center to explain about the project. Over 2800 people visited this center and learned about the project, TenneT and high voltage infrastructure.
- **Living environment**  
The living environment, how a person feels about a certain area, is affected by the presence of the steel pylons and overhead lines. No impact on the living environment is assumed since 68 mastlocations have been taken away, also out of the city of Doetinchem. And 54 new mastlocations have been created, with higher masts however.
- **Grid availability**  
No effect assumed on grid availability for the Netherlands. Grid availability figure of the Netherlands will not change significantly due to this interconnector..

## Environmental

Material depletion, biodiversity & water use and carbon emissions have been analysed and measured. Other environmental effects like water pollution, waste production, land use were not in scope.

- **Material depletion**  
The value of the used aluminium and steel is taken into account, because both are major components in our infrastructure. Of the environmental impact, material depletion has the largest impact due to the high amount of materials used.
- **Biodiversity & water use**  
During the project trees have been removed, replanted, water has been drained. Both the negative and positive impact has been taken into account.
- **Carbon emissions**  
To calculate the carbon emissions we estimated and/or calculated the emissions related to; production materials, travel in the construction phase, use of machines during the construction phase and grid losses during the operation phase. Grid losses, since they occur during 40 years of operation, have most impact on the carbon emissions.

## Economical

Economical impact (salaries paid in the Netherlands), investment costs, maintenance costs, operational costs and electricity prices have been taken into account.

- **Economical impact (salaries paid in the Netherlands)**  
The economical impact of the project which is connected to the salaries paid in the Netherlands is taken into account, because it is assumed Dutch employees most likely spend most of their salary in the Netherlands.
- **Investment costs**  
The investment costs are related to the costs for purchase of materials and the construction work.
- **Maintenance costs**  
All activities related to maintenance, from visual inspection to actual repair activities have been taken into account.
- **Operational costs**



A large part of the operational costs relate to grid losses. Therefore we focused on these costs and did not include other operational costs.

- Electricity prices

An important objective of an interconnector is connecting electricity markets to establish an equal electricity price. The effect of this interconnector on the Dutch electricity price is taken into account.

## Uncertainties

The final result are not an absolute truth. There are several uncertainties:

- We focused on most material effects, thereby excluding minor impacts
- Monetizing non-financial data is relatively new, conversion factors are not fixed
- Some data is based on assumptions
- Impact is reported for a period of 40 years, existing data has been used to forecast impact

## Conversion factors

Below the conversion factors applied for the case studies.

Impact area	Conversion factor	Value	Unit	Source
<i>General</i>				
40 years	Net present value (NPV)	2,9	%	TenneT internal documentation
<i>Society</i>				
Construction nuisance	Value travel time	9	Euro/hour	<a href="https://www.transportation.gov/sites/dot.dev/files/docs/vot_guidance_092811c.pdf">https://www.transportation.gov/sites/dot.dev/files/docs/vot_guidance_092811c.pdf</a>
Lost work time due to safety incidents	Average salary	80	Euro/hour	TenneT internal documentation
Education costs	Average costs of education	34,29	Euro/hour	<a href="http://statline.cbs.nl/StatWeb/publication/?VW=T&amp;DM=SLNL&amp;PA=81848NED&amp;LA=NL">http://statline.cbs.nl/StatWeb/publication/?VW=T&amp;DM=SLNL&amp;PA=81848NED&amp;LA=NL</a>
Living environment	- Compensation for value loss houses near high voltage lines	Depends on the situation		<a href="http://www.tennet.eu/fileadmin/user_upload/Company/Publications/Position_Papers/Dutch/Position_Paper_Uitkoopbeleid_bij_nieuwe_bovengrondse_hoogspanningslijnen.pdf">http://www.tennet.eu/fileadmin/user_upload/Company/Publications/Position_Papers/Dutch/Position_Paper_Uitkoopbeleid_bij_nieuwe_bovengrondse_hoogspanningslijnen.pdf</a>
	- Price influence on house prices within 300m outside EMS from steel pylons	1,5	%	<a href="http://papers.tinbergen.nl/14124.pdf">http://papers.tinbergen.nl/14124.pdf</a>
<i>Environment</i>				
Material depletion	Costs for material depletion aluminum	1,8/0,94	Euro/kg	<a href="http://www.ecocostsvalue.com">http://www.ecocostsvalue.com</a>
	Costs for material depletion steel	0,04		
Biodiversity	- Capture particulates by trees	0,1	Kg/tree	Teeb.stad Bronvermelding kengetallen TEEB-stad tool
	- Costs particulates per year	95	Euro/yr	
Carbon emissions	Carbon conversion factor	100	Euro/tonnes	<a href="https://www.natuurenmilieu.nl/wp-content/uploads/2016/06/NM-Energievisie-juni-2016.pdf">https://www.natuurenmilieu.nl/wp-content/uploads/2016/06/NM-Energievisie-juni-2016.pdf</a>

## Questions

If you have any questions or would like to receive more information, send an email to [CSR@tennet.eu](mailto:CSR@tennet.eu).