European Network of Transmission System Operators for Electricity

entsoe

# SOCIO ECONOMIC CONTRIBUTION OF TYNDP 2020 PROJECTS IN THE EUROPEAN UNION

February 2021

# TABLE OF CONTENTS

# 1 OVERVIEW

ENTSO-E has, for the first time, approximated the impact of TYNDP projects on the European Union's economy to highlight the direct benefits projects included in the Ten-Year Network Development Plan (TYNDP) deliver to Europe. ENTSO-E believes this study is especially poignant given the economic recovery that must be undertaken post-pandemic. The results of this so-called Job Estimation of ENTSO-E Projects (JEEP) study are presented in this report.

The origin of this idea is simple: any transmission or storage investment stimulates the economy. It engages businesses in various industries across multiple sectors and releases commercial exchanges between European countries. Trade and logistics of materials attached to the construction and maintenance of investment projects assessed in the TYNDP stimulate macro economies by generating large revenues for companies at each link of the value chain. At the micro-economic level, salaries earned by employees working for engaged companies then have disposable income which is put back into their country's economy through household consumption. Both industry and households pay taxes that governments re-invest in their respective societies through public spending.

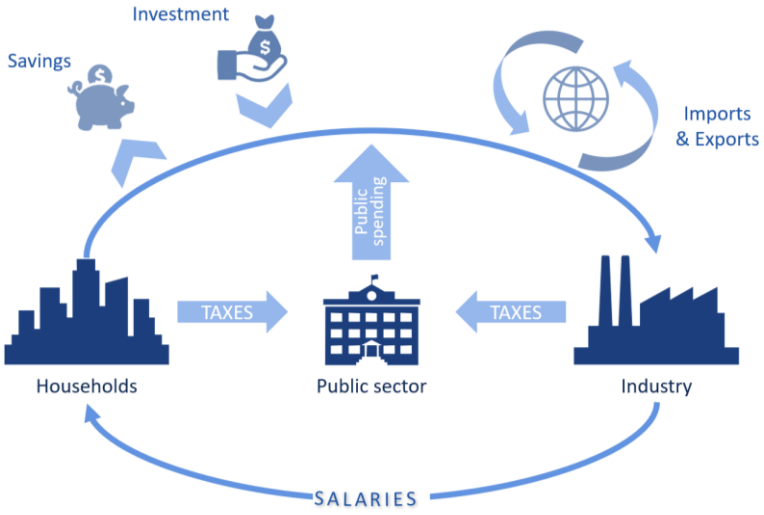


Figure 1. Any investment stimulates the economy

The employed methodology to calculate each project's economic value is based on the input-output model developed by Wassily Leontief. Leontief's model quantified the interdependencies between economic sectors. The interdependency between sectors is quantified in so-called input-output tables (IOTs) which can then be used to calculate how much output is produced by relevant sectors to produce the main investment. An input-output assessment is therefore a high-level quantification of sector engagement and production flows in the macro economy related to the realization of a single investment. In this study, the World Input-Output Database was used which had tables available for each European Union country.

This type of analysis is not new, in fact it is one of the most widespread tools for this type of assessment, with applications to all types of activities.

The aim of this report is to present a brief description of the methodology used by ENTSO-E to assess the economic potential of the TYNDP portfolio. For readers who want more detailed information are directed to a CIGRE paper presented in the 2020 Paris Session: "C1-118".

# 2 GENERAL APPROACH

There are different approaches to estimate how investments can contribute to economic development. The methodology used by ENTSO-E has been developed by Red Eléctrica Group (REE) in collaboration with CEPREDE[2]. It is based on the information supplied by Input-Output Tables (IOT) that consider the relationship between sectors and countries and thus, the economic flows of the economy.

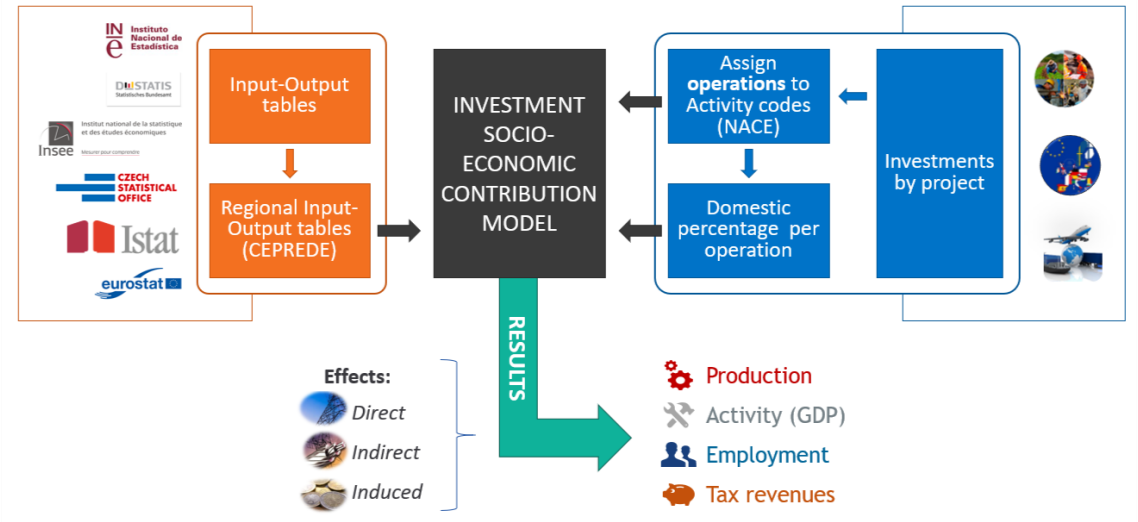


Figure 2. Schematic view of the methodology

This document will present the general structure, as well as Input-Output fundamentals of estimating an investment's macro-economic contribution, by measuring its impact. To do so, it is necessary to:

a) Identify the main goods and service flows that constitute the investment. It requires the IOT tables, and National Accounting of every country, and the investment by project with the breakdown in the different industry sectors. Material imports from outside the European Union must also be considered as these are required to build a single investment, however non-European imports are not considered to have an impact on European country's economies.

b) Compute the macro-economic effects (direct, indirect and induced) in terms of Gross Domestic Product (GDP) and employment, as well as the induced government revenues. Effect definitions are supplied in the list below.

- **Direct Effect**: estimates and valuates the influence of the investment on the economic system from an initial impact. That is, the value of the contracts signed with awarded companies (awardees).

- **Indirect Effect**: the different economic agents will need to acquire other goods and services (intermediate consumption) from the rest of the productive system and so on.

That is, the contracts made by the direct awardees with other economic agents to develop their activity.

- **Induced Effect**: collects the impact derived from all the income generated in the previous stages, and usually considers the effect on the private consumption and government revenues.

### Study input sources

At a national level, the Nationals Statistics Institute computes and publishes Input-Output tables within the country. So, it is possible to compute the effects inside a country, but imports of goods and services must be excluded because these productions have been made outside the country and therefore do not have an impact on the national economy.

To perform the calculation at European level, the one relevant for the ENTSOE projects, the results of the FIGARO (Full International and Global Accounts for Research in Input-Output Analysis) **1** project, developed by the European Union, has been used. These Input-output tables consider the relationship between sectors within a country but also quantify interdependencies between the European countries' economies.

ENTSO-E approached a sample group of project promoters who were asked to provide a detailed cost breakdown of their projects. The input-output assessments of these projects were then extrapolated to represent the rest of the portfolio. As stated before, the JEEP study is a pilot study for ENTSO-E and thus the methodology presented here is the first step towards a holistic economic impact assessment of TYNDP projects.

# 3 INPUT-OUTPUT TABLES FUNDAMENTALS

Input-Output Tables (IOTs) are an accounting document integrated in National Accounts System that considers all economic transactions done in an economy during a period (usually a year). They can be computed at regional, national or supranational level, and are structured by branches of activities and typology of goods and services from both production and consumption perspectives.

IOTs date back to 1936 with the first works published by the Nobel Prize Wassily Leontief in "The review of Economic and Statistic". Eurostat is the institution in charge of calculating them for the European Union.

The Input-output framework considers three kind of tables: Supply, Use and Symmetric. The later one corresponds to a square matrix structure that allows the analysis implemented in estimating the macro-economic contribution of the investments.

A detailed description of Input-Output methodology can be found in the Eurostat document: Manual of Supply, Use and Input-Output Tables[2], although the following basic information has been extracted from it:

[1] *https://ec.europa.eu/eurostat/web/experimental-statistics/figaro*

[2] *https://ec.europa.eu/eurostat/documents/3859598/5902113/KS-RA-07-013-EN.PDF/b0b3d71e-3930-4442-94be-70b36cea9b39*

*"Supply and use tables provide a detailed picture of the supply of goods and services by domestic production and imports and the use of goods and services for intermediate consumption and final use (consumption, gross capital formation, exports). The use table also shows how the components of value added (compensation of employees, other net taxes on production, consumption of fixed capital, net operating surplus) are generated by industries in the domestic economy. Thus, supply and use tables give detailed information on the production processes, the interdependencies in production, the use of goods and services and generation of income generated in production. After balancing supply and use table provide coherent data linking industries, products and sectors."*

Following there is a simplified schema of both tables:

**Table 1 Supply of goods and services.**

| Industries / Products | Industries | | | Imports | Total |
|---|---|---|---|---|---|
| | Agriculture | Industry | Service activities | | |
| Agricultural products<br>Industrial products<br>Services | Output by product and by industry | | | Imports by product | Total supply by product |
| Total | Total output by industry | | | Total imports | Total supply |

**Table 2 Use of goods and services.**

| Industries / Products | Industries | | | Final uses | | | Total |
|---|---|---|---|---|---|---|---|
| | Agriculture | Industry | Service activities | Final consumption | Gross capital formation | Exports | |
| Agricultural products<br>Industrial products<br>Services | Intermediate consumption by product and by industry | | | Final uses by product and by category | | | Total use by product |
| Value added | Value added by component and by industry | | | | | | Value added |
| Total | Total output by industry | | | Total final uses by category | | | |

*"The supply and use tables also form the basis for deriving symmetric input-output tables by applying certain assumptions for the relationship between outputs and inputs"*. The assumptions used to derive symmetric tables[3] are related to the product technology, the Industry technology and the structure of industry and products sales.

[3] *Readers are directed to the Eustat website for further information: https://en.eustat.eus/documentos/elem_15550/definicion.html*

**Table 3 Simplified symmetric input-output**

| Products / Products | Homogeneous units of production | | | Final uses | | | Total use |
|---|---|---|---|---|---|---|---|
| | Agricultural products | Industrial prodcts | Services | Final con-sumption | Gross capital formation | Exports | |
| Agricultural products<br>Industrial products<br>Services | Intermediate consumption by product and by homogeneous units of production | | | Final uses by product and by category | | | Total use by product |
| Value added | Value added by component and by homogeneous units of production | | | | | | |
| Imports for similar products | Total imports by product | | | | | | |
| Supply | Total supply by homogeneous units of production | | | Total final uses by category | | | |

Starting from the symmetric table, a technical coefficient can be defined computing the intermediate consumptions per unit produced for every activity so, we can get a technical coefficient matrix for every activity and product. If the technical coefficient matrix mentioned above is subtracted from the identity matrix, and the resulting matrix is inverted, the so-called Leontief Inverse Matrix can be obtained. This matrix is the foundation of the assessment outlined in this report.

# 4 HOW ARE THE EFFECTS COMPUTED?

To have an idea about how the direct, indirect and induced economic effects are computed, a simplified example is presented in this section.

## Direct effect

Suppose 1,200,000 Euros investment of a TSO project of which 200,000 Euros are necessary to import electric equipment from non-EU countries. Thus, the direct investment in the EU is 1,000,000 Euros. ENTSOE analysis is focused only on the effect within EU countries, to simplify the analysis and due to the availability of input data.

To carry out the investment, a company is contracted by the Investor for an amount of 1,000,000 Euros (**Output**). This company has a productivity per employee of 125,000 Euros, so the investment gives work to **8 employees** (full time equivalent). If the average wage of the company is 40,000 Euros, it means that the company must pay wages for a total of 320,000 Euros to develop the activity. On other hand, the awarded company must make purchases and expenses for a total of 450,000 Euros, which means that it generates an **added value of 550,000** Euros (GDP), according to the average ratio of every sector in the national accounting. This added value, minus the wages paid to the workers, suppose a surplus of 230,000 Euros to the company.

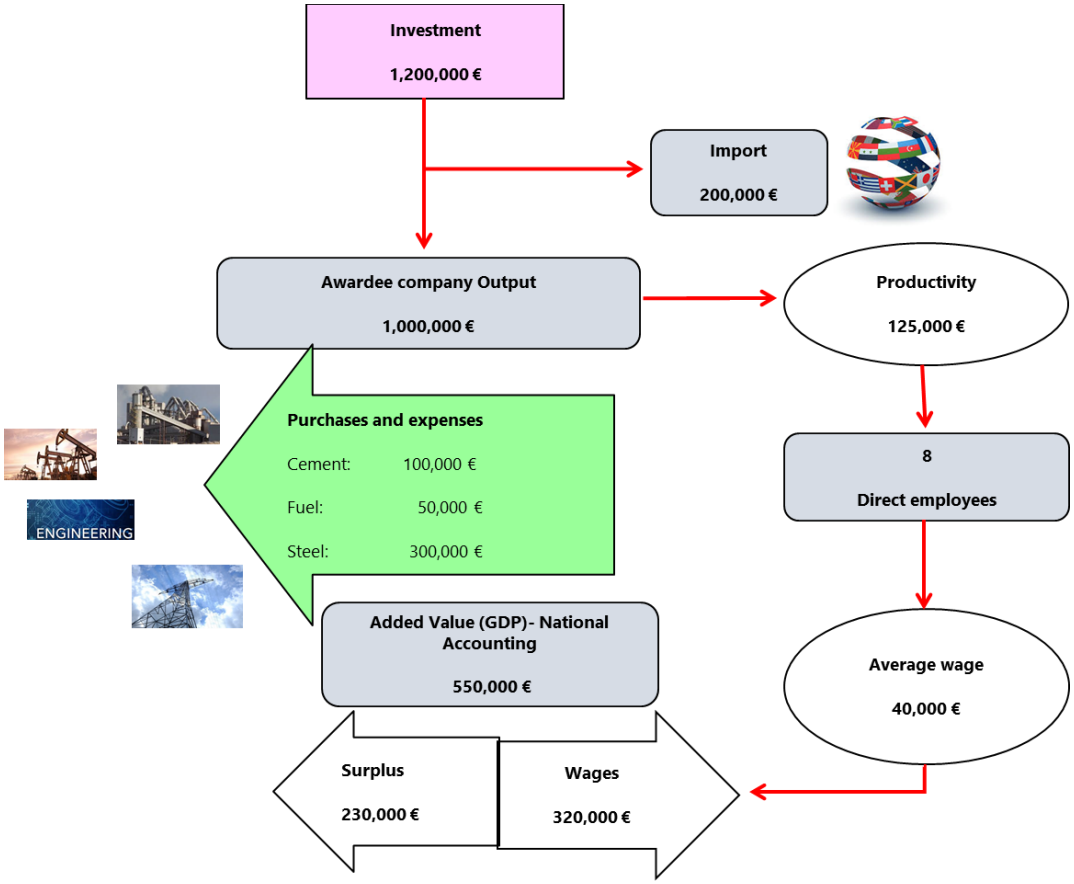


Figure 3. Direct effect example

## Indirect effect

The awarded company can't develop its activity using only its own resources so it contracts other companies who, in turn, can sub-contract others. This is the way in which one investment acts like a trigger that starts commercial flows. The follow-on effects of which are quantified in the IOTs. In this example, the awardee buys goods and services worth 450,000 Euros from various suppliers. To meet the client company's demand, these suppliers then must buy material necessary to produce the demanded good. This means that 380,000 Euros (of the original 450,000EUR) is passed down the value chain from these suppliers. As a result, a total **indirect output** of 1,100,000 Euros has been generated from the initial investment value of 1,000,000 Euros. Using the same argument applied for direct effects and with information included in Input-Output tables, an **indirect added value** (GDP) of 550,000 Euros and **indirect employment** of 10 people (full time equivalent) can be computed.

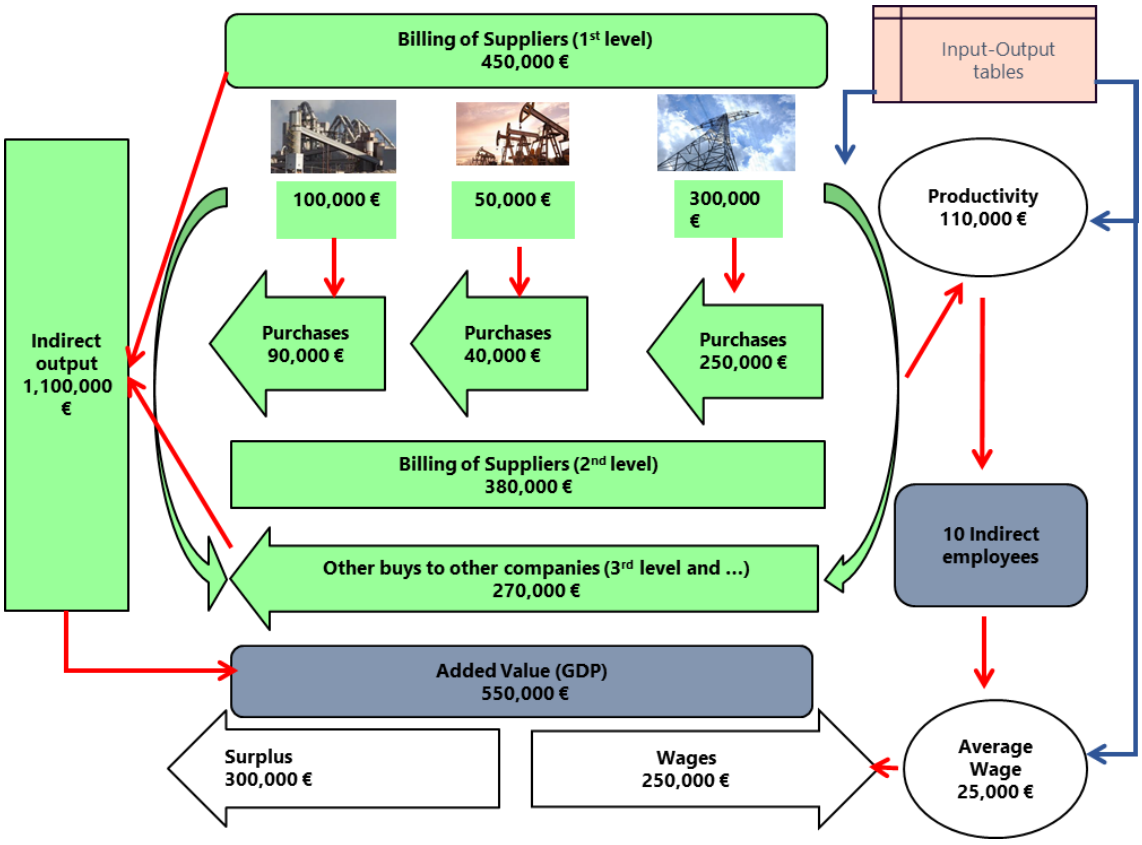


Figure 4. Indirect effect example

### Induced effect

Finally, the indirect effects are computed considering the values of employment (and wages) estimated in the previous steps. The total of 18 employees (direct and indirect) receive wages for 570,000 Euros. This income, besides paying taxes to the company's operating country, also contributes to the micro economy through consumer-level savings, investments and consumption. Based on average rates provided in the used Input-Output tables, it is possible to estimate the proportion of the total income dedicated to savings and paid taxes, so the difference with respect to total income will be dedicated to final consumption. Thus, the total income can be split up in 205,000 Euros dedicated to pay taxes, 34,000 Euros for savings and 331,000 for final consumption. These 331,000 Euros mean an induced output for the final consumption company's providers but the consumption acts as a trigger for the economy, as the investment effect does. Therefore, these companies must demand new products from their suppliers inducing an additional output of 145,000 Euros. The information contained in the Input-Output Tables gives, again, the relationships among economic sectors and allow the induced employment and the induced contribution to GDP to be estimated.

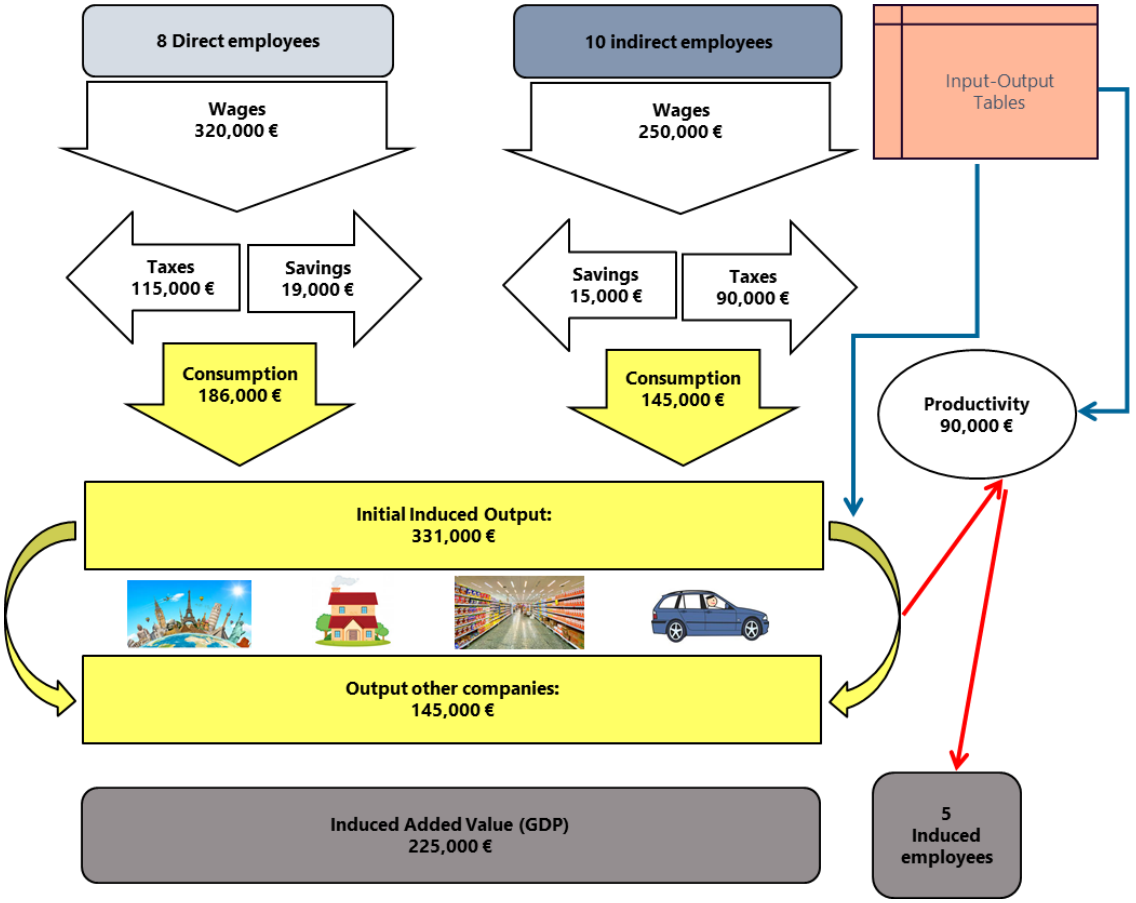


Figure 5. Induced effect example

# 5 STUDY ASSUMPTIONS

This exercise has been considered as a pilot project within the TYNDP, as it is the first attempt to estimate the socio-economic impact of the investments of the TYNDP project portfolio in the European Union (imports from outside EU-27 are not considered). As a pilot project the

methodology was applied to a representative sample of projects chosen from the TYNDP 2020 portfolio and their results were then extrapolated to the entire project portfolio.

9 projects were selected considering the type of the transmission elements and the geographic area on which they could be located, using more detailed project cost breakdowns provided by a sample group of projects in the TYNDP portfolio. Project promoters were asked to break down the main investment cost into sub-components covering maintenance, production and material goods necessary to assemble their investment. In case project promoters were unable to provide the requested information, the study team requested, simplified assumptive parameters were applied instead. The most relevant are listed below.

- An average rate of purchases among the economic sectors or an average breakdown by economic sectors for every transmission element type was applied in case no information was available. For example, how much of the investment cost is used to buy the necessary machinery and equipment from the manufacturing sector etc.

- The investments related to international interconnections has been allocated to each neighboring country according the 50/50 rule or 1/3 if three countries are involved.

- The estimation of production, GDP, employment and government revenues have been assessed from the starting of the project at the permitting stage until the commissioning date.

These assumptions, although not perfect, did enable the team to perform a consistent assessment of all selected projects and to extrapolate the results to the rest of the TYNDP portfolio.

# 6 RESULTS

The results show that during the construction and commissioning of the projects in the TYNDP 2020 project portfolio:

- 118 billion Euro of Capital expenditure will be invested in European Union countries.
- 1.7 million full time equivalent jobs would be ensured.
- Close to 240 billion Euros would be mobilized in production to cover the necessary goods and services to commission all investments in the TYNDP 2020 portfolio.
- The European Union's GDP could increase by about 100 billion euro.
- And public administration revenues through taxes collection could reach about 45 billion euro, a value that could return in them European society.

These results indicate that investing in transmission and storage infrastructure would not only lead to a decarbonised energy future and deliver the subsequent benefits assessed in the TYNDP's cost-benefit analysis, but also improve the lives of European citizens by investing directly into their jobs and their future. The benefits calculated by this assessment illustrate that the TYNDP portfolio, if fully realised, would deliver substantial employment and economic benefits to Europe and Europeans. Employment over several years would be guaranteed as large-scale transmission and storage projects require several years to construct. The reader is encouraged to look at project-specific information in the TYNDP 2020 project sheets and see the projected commissioning years to see the number of years these benefits would be distributed over.

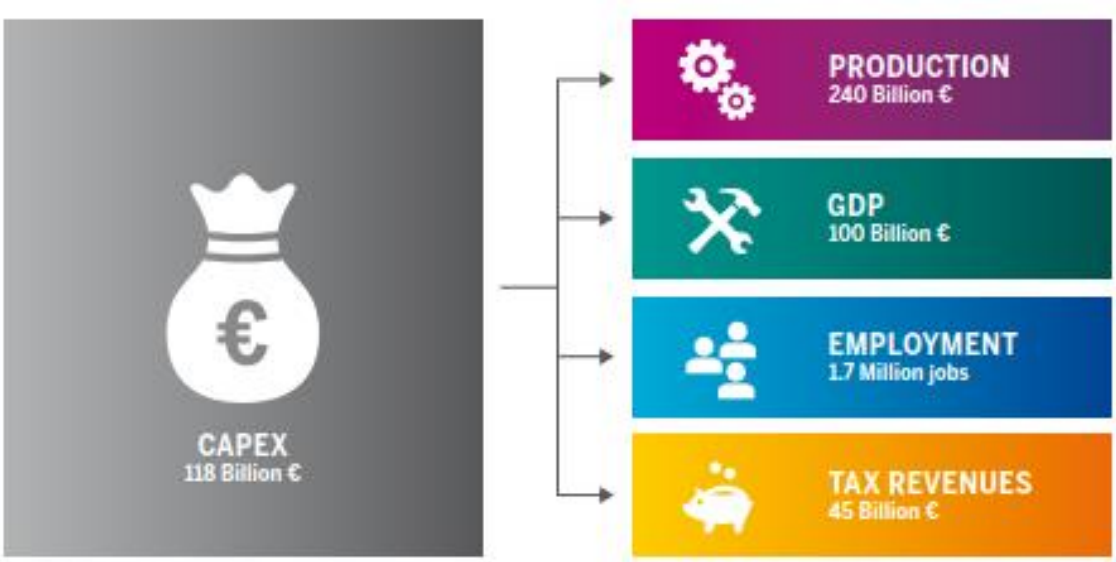


Figure 6. Summary of results

# APPENDIX

The following chart shows the breakdown of the investments by type of investment. Furthermore, the results of the applied methodology, estimating the employment, output, gross value added and government revenues are also unbundled by investment type. Cables, both subsea and underground are the type of facility which produces the highest value overall.

| | Estimated | Number | Million of € | | |
|---|---|---|---|---|---|
| **ElementsType** | **Capex (M€)** | **Employment** | **Output** | **GVA-Income** | **Government Revenues** |
| Compensation | 2.851 | 29.997 | 5.280 | 2.323 | 1.102 |
| LCC Converter Station | 530 | 6.523 | 1.048 | 416 | 181 |
| Overhead Line | 21.579 | 294.292 | 43.032 | 18.543 | 7.908 |
| Phase Shift Transformer | 297 | 3.702 | 624 | 247 | 117 |
| Storage | 14.364 | 211.548 | 30.859 | 12.596 | 5.249 |
| Subsea Cable | 46.573 | 688.128 | 93.970 | 39.136 | 18.078 |
| Substation | 3.785 | 56.042 | 7.498 | 3.163 | 1.455 |
| Underground Cable | 28.067 | 404.332 | 56.329 | 24.835 | 11.236 |
| | | | | | |
| **Total** | **118.046** | **1.694.563** | **238.641** | **101.259** | **45.326** |

Table 4. Detailed results per type of investment