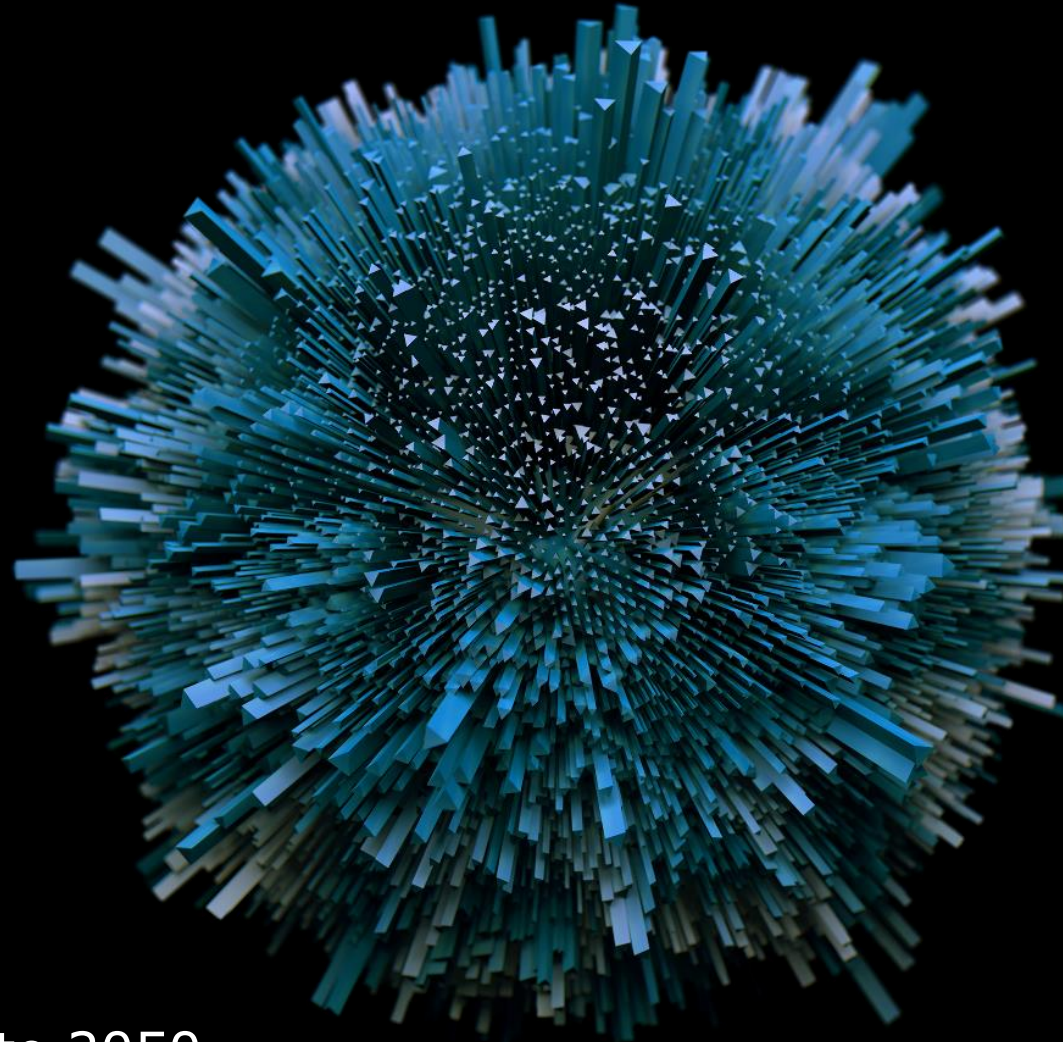




Executive Summary

Impact Report - Vision to 2050

Foratom – European Atomic Forum

Brussels
April 25, 2019

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1

Key messages and background

Key messages of The Report

Besides playing a key role in decarbonization, nuclear industry would enhance economic welfare at National/ European level

Nuclear characteristics: low carbon technology, labor intensive, highly skilled workforce, cost competitive; key cost drivers include reactor construction and labor force during operation phase

A High Scenario with 150 GW nuclear capacity would entail additional economic growth and employment in the nuclear sector, its supply chain and the EU economy as a whole



Impact Report as an instrument for key decision makers; reliable forecast and measurability of future benefits deriving from a nuclear capacity of 150 GW throughout the European Union.

Nuclear power generation mitigates the environmental footprint of the European power system and could play a key role in achieving the EU decarbonization target

Background

The analysis was conducted by Deloitte on behalf of FORATOM, taking into consideration the EU context and certain prerequisites for the nuclear sector



EU CONTEXT

- ✓ In 2016, the European Union reaffirmed its commitment to decarbonize its energy mix
- ✓ - 45% target below 2005 levels for EU GHG emissions in 2030, by **2050 – net zero**
- ✓ **Growing role** of electricity, as its share in final energy consumption is expected to increase from 20% in 2015 to more than **40% by 2050**
- ✓ Besides advantages resulting from low-carbon technology and increased security of supply, nuclear generation has **positive impact** on affiliated industries and the economy as a whole
- ✓ A **stable regulatory environment** and **market design** are crucial for triggering investment decisions and successful execution of nuclear projects



PREREQUISITES

- ✓ **95% decarbonization** of the energy mix in 2050 compared to 1990
- ✓ Electrification of the European economy: 2050 demand forecast is projected to reach around **4,100TWh**, compared to 3,100 TWh today
- ✓ The study is focused on a period of **30 years** for the analyzed scenarios, starting with 2019
- ✓ The historical input data was collected from available public sources (EC, EP, Eurostat, IAEA, ISCO, WNA) and Deloitte data
- ✓ The forecasts were projected based on FTI **assumptions** regarding the **evolution of the EU nuclear industry**



IMPACT ON



Public revenues



Disposable household income



Employment

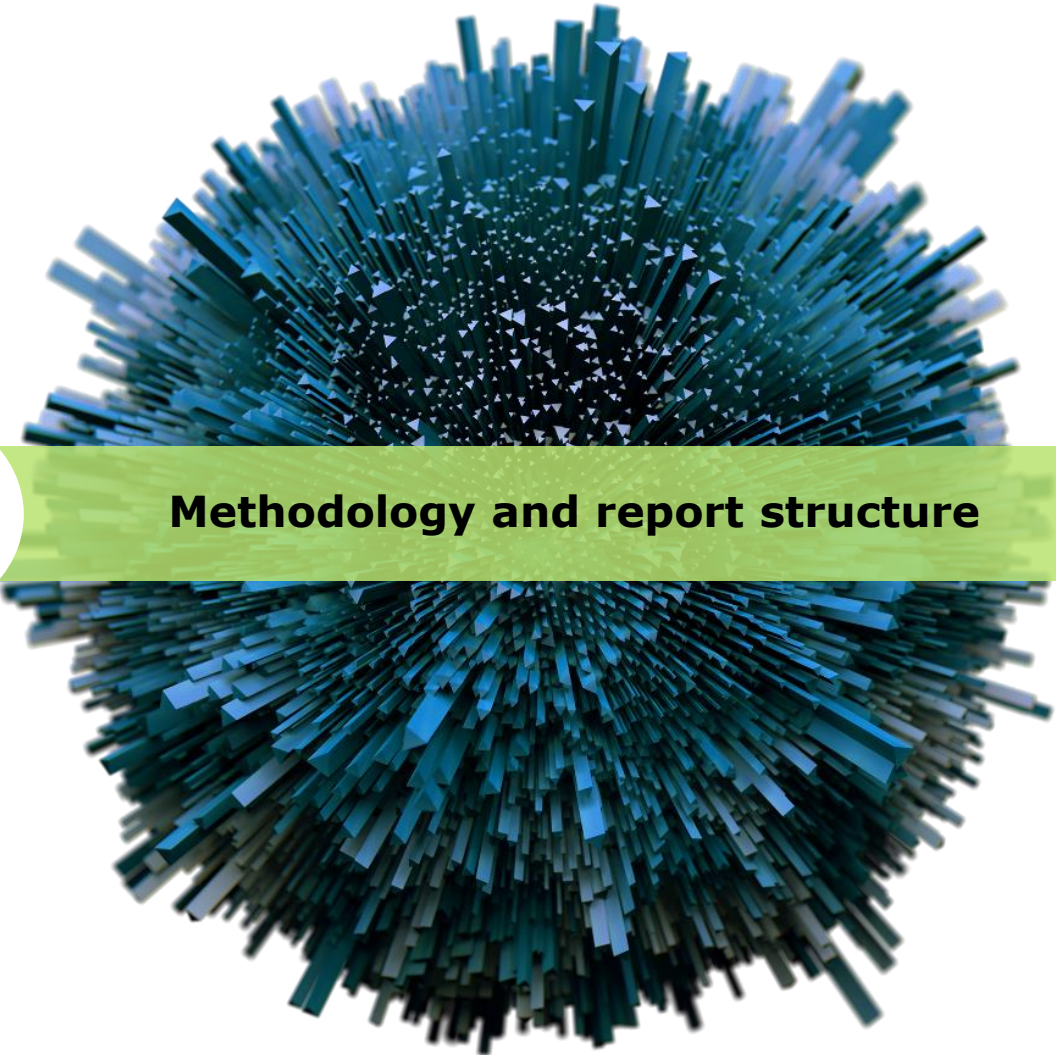


GDP



Trade balance





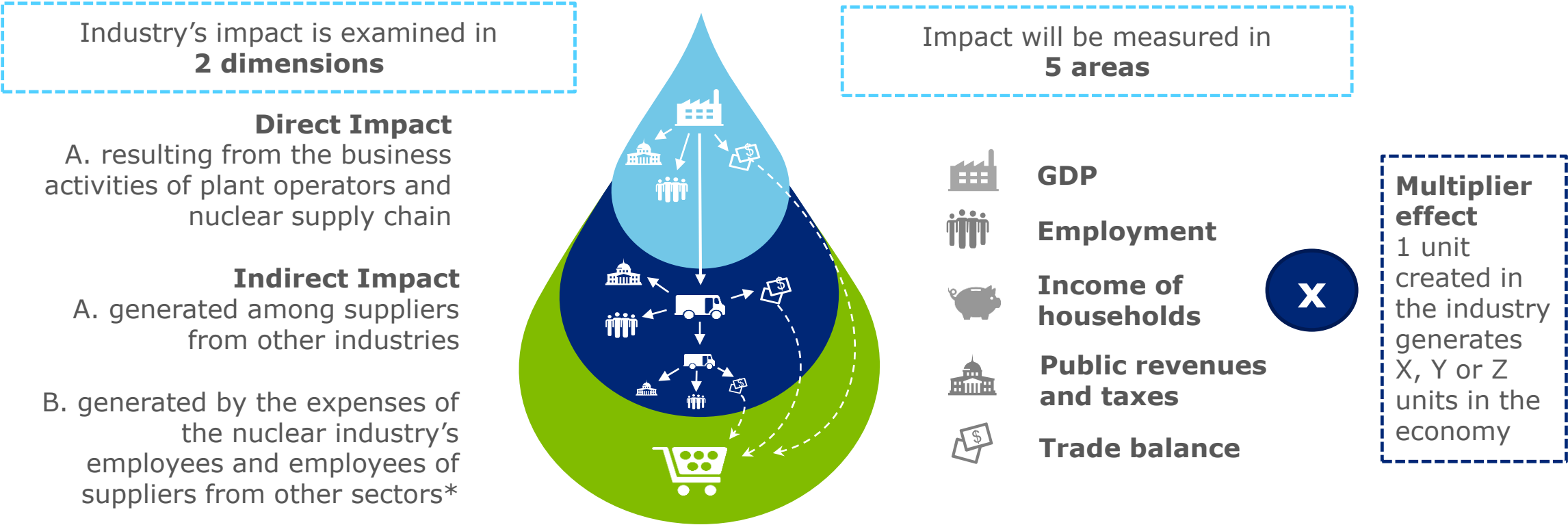
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Methodology and report structure

Methodology

CGE (Computable General Equilibrium) Model used to assess the impact of the nuclear power sector on the EU economy

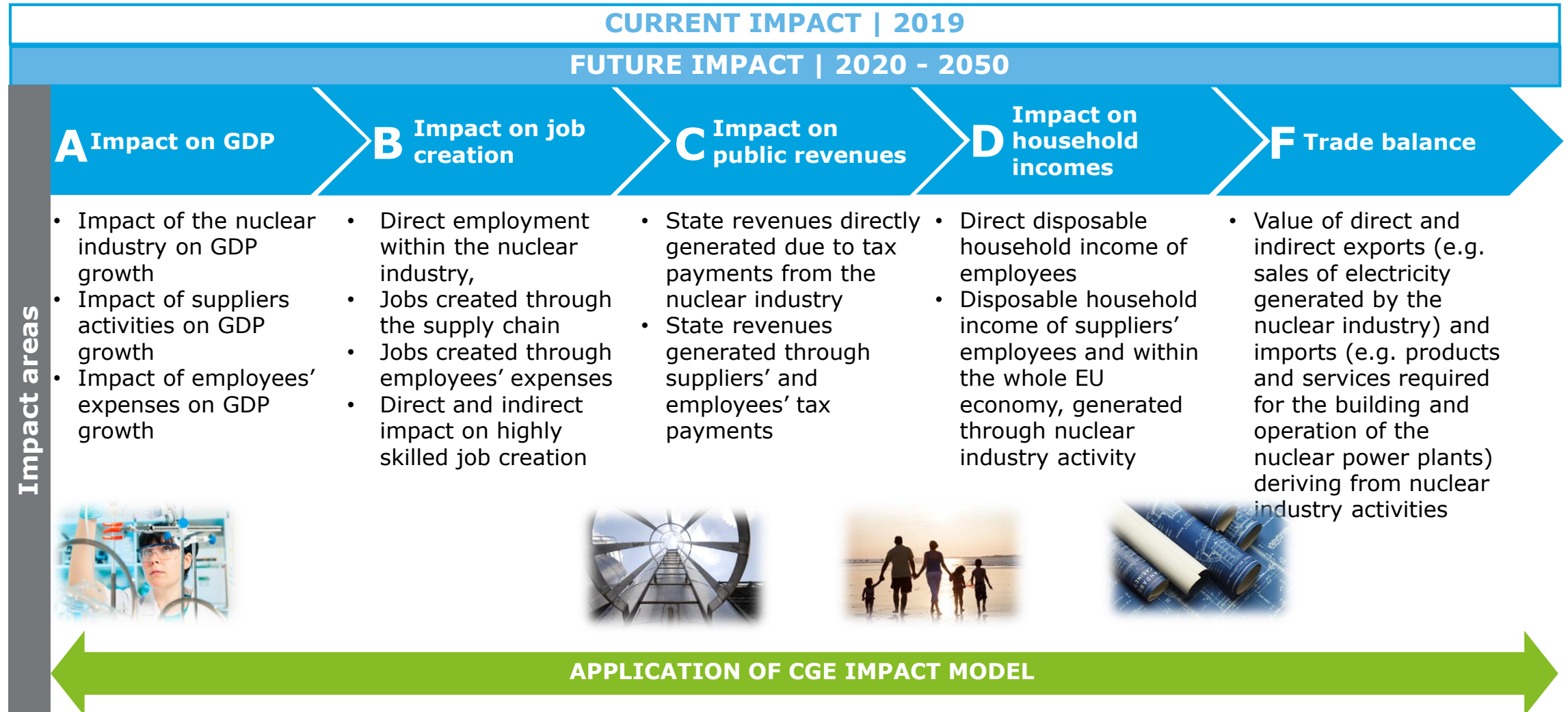
The **CGE model** merges the concept of general equilibrium developed by Arrow-Debreu (1954) and input-output analysis developed by Vasily Leontief. This quantitative tool simulates the macroeconomic linkages within a selected geographic region and measures the impacts in several areas of the economy. The results of the modelling exercise are particularly useful in examining the total effects of an economic activity or of a change in the level of that activity. The model is recursively dynamic - that means that effects of policies are introduced in the dynamic context and the effects of actions introduced in one period will affect the economy in the following periods, as well.

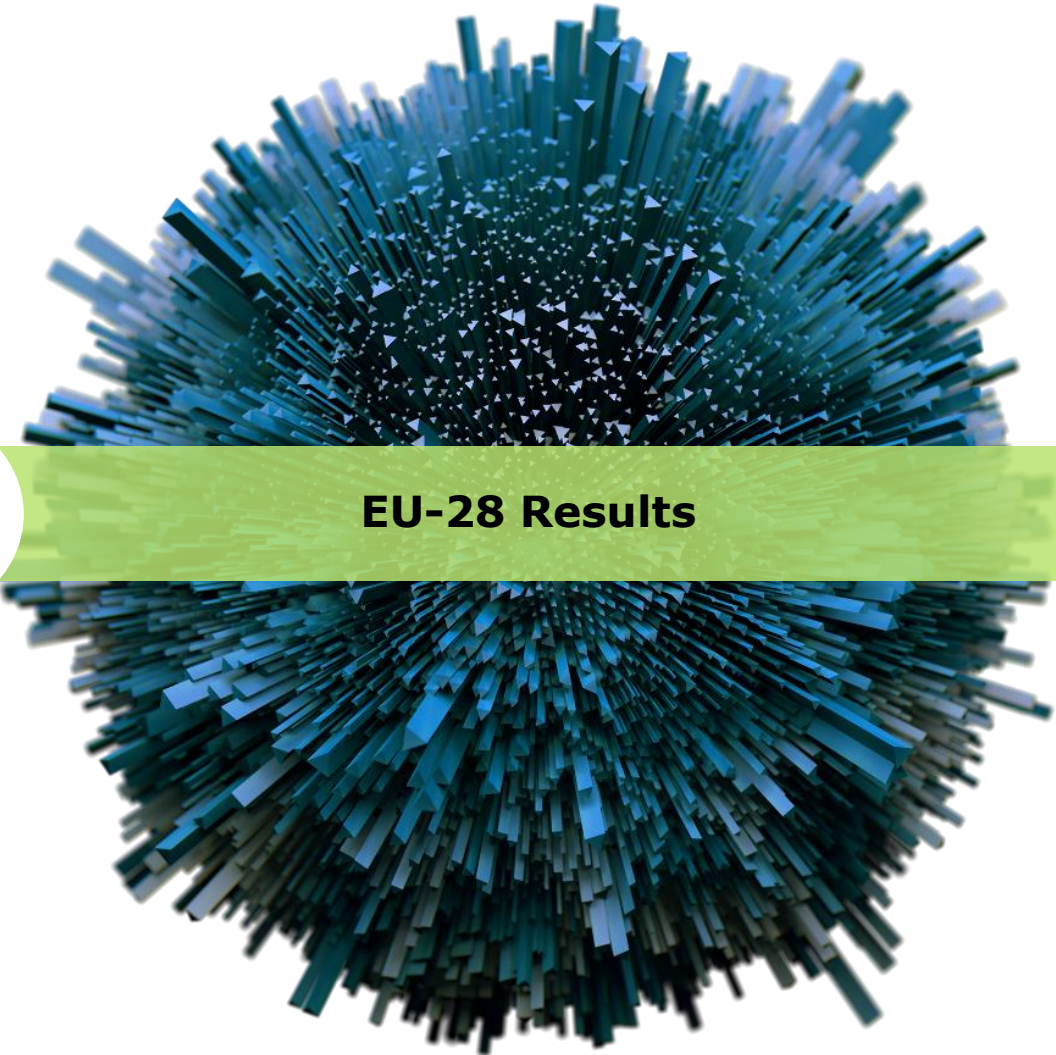


*The **indirect impact** dimension consists of both indirect and “induced” effects, if compared to the Input-Output-Model, which is frequently used to assess impacts of an entity/ sector in a national economy.

Report structure

The impact assessment is divided in three parts and analyses five impact areas in which current and future impact is measured throughout the European Union





3

EU-28 Results

3.1 CURRENT IMPACT

2019

Overview of results

The nuclear sector has today a significant impact on the European economy, supporting over 1.1 million jobs throughout the 28 Member states

2019 IMPACT

507.4
bn. EUR

in **EU GDP** generated by nuclear sector, equal to a 3 – 3.5% share of 2019 EU GDP

1,129,900

average **number of jobs sustained** by the nuclear sector

47%

of the total number of **jobs in the nuclear industry are highly skilled**, equaling a number of **531,900**

383.1
bn. EUR

disposable household income due to the activities of the EU nuclear industry

124.2
bn. EUR

public revenues generated through tax payments due to the nuclear sector

18.1
bn. EUR

trade surplus within EU due to the nuclear sector

Multiplication effect of installed nuclear capacity in the EU economy

1 GW installed nuclear capacity translates into 4.3 billion Euro in the EU GDP

1 GW¹⁾



**1 GW INSTALLED
NUCLEAR CAPACITY
GENERATES...**

2019 IMPACT

¹⁾ With a total capacity of 118 GW in 2019

4.30 bn. EUR

9,575

4,508

3.25 bn. EUR

1.05 bn. EUR

0.15 bn. EUR

in the **EU GDP**

jobs in the EU economy

highly skilled jobs in the EU

annual **household income**
in the EU

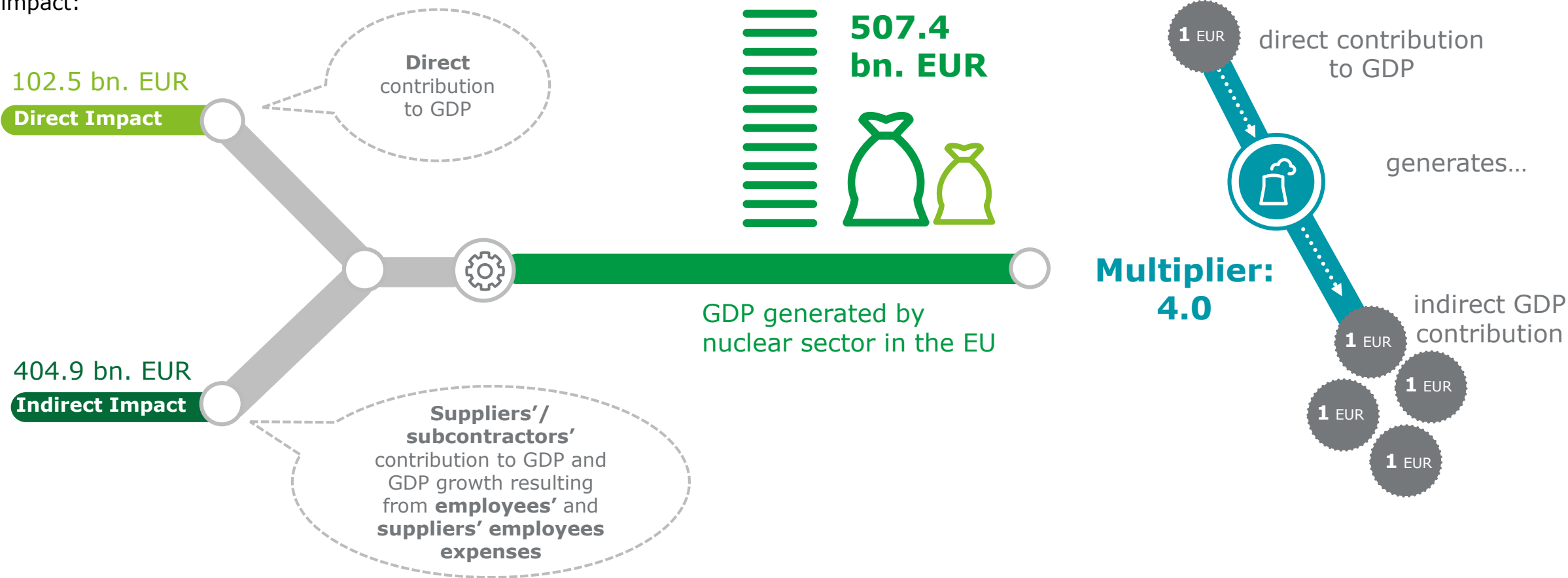
annual **public revenues** in the EU-
28 countries

annual **EU trade surplus**

A. GDP Impact

Every Euro of the nuclear industry’s direct contribution to EU GDP generates an indirect contribution of 4 Euro, totaling an impact of 5 Euro in the EU GDP

GDP generated through the EU nuclear sector, broken down by types of impact:



B.1 Job creation

Every job created directly in the nuclear sector sustains another 2.2 jobs, totaling an impact of 3.2 jobs on the EU labor force market

Jobs created through the nuclear sector in the EU, broken down by types of impact:

351,900 jobs

Direct Impact

Jobs created **within** the industry

777,900 jobs

Indirect Impact

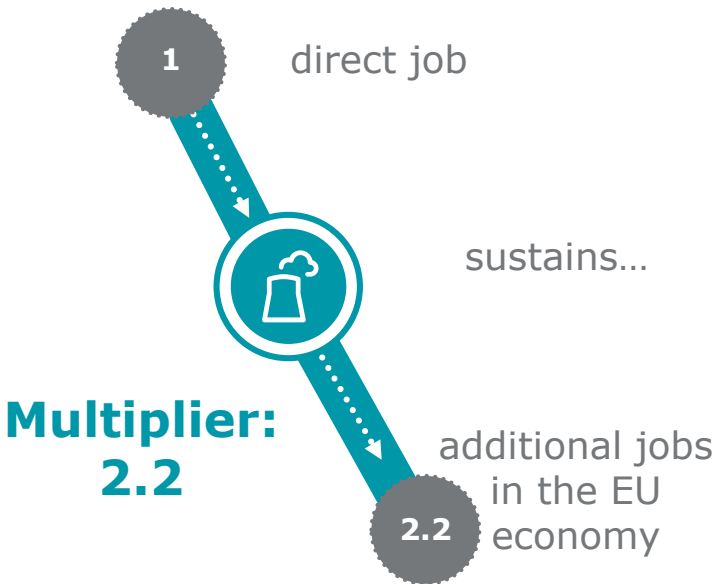
Jobs created **through suppliers employees' and suppliers' employees expenses**



Total number of jobs sustained due to the EU nuclear sector

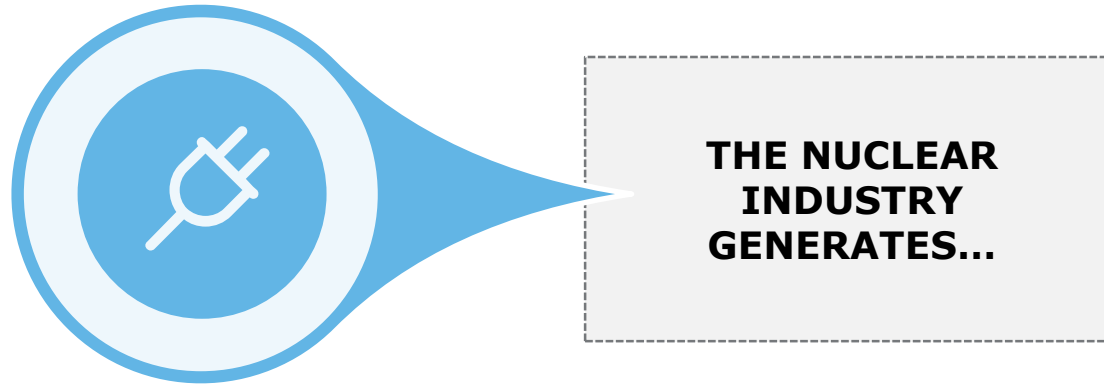
47%

Out of which **531,900** jobs are **highly skilled**



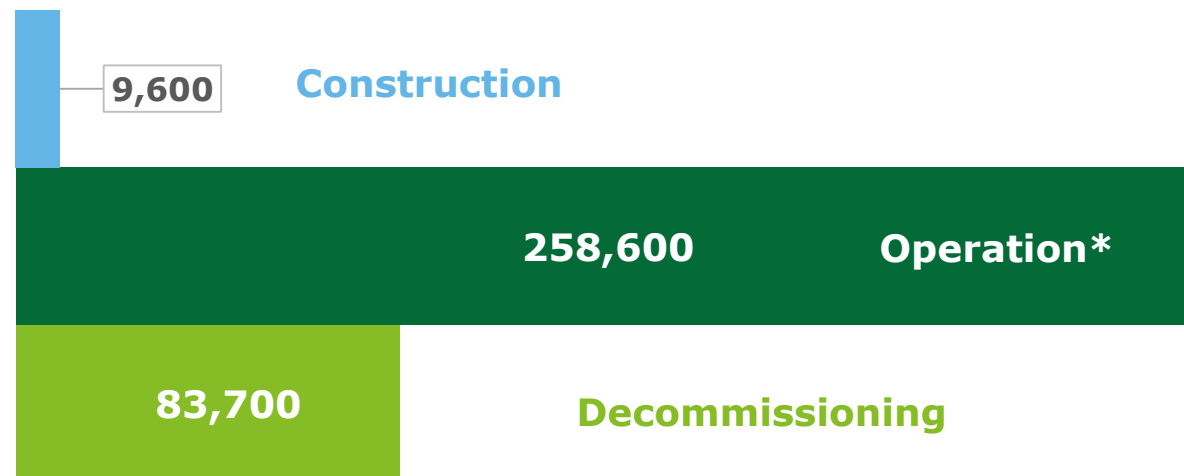
B.2 Job creation

In 2019, around 70% of direct jobs sustained by the industry are during the operation phase



2019 average impact

351,900 direct jobs
in power plants and the
nuclear fuel cycle throughout
the **EU**, out of which

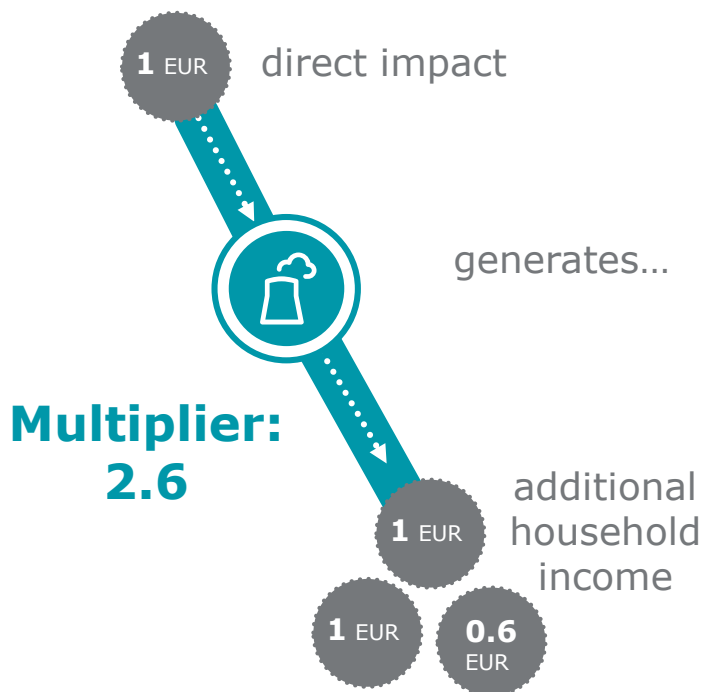
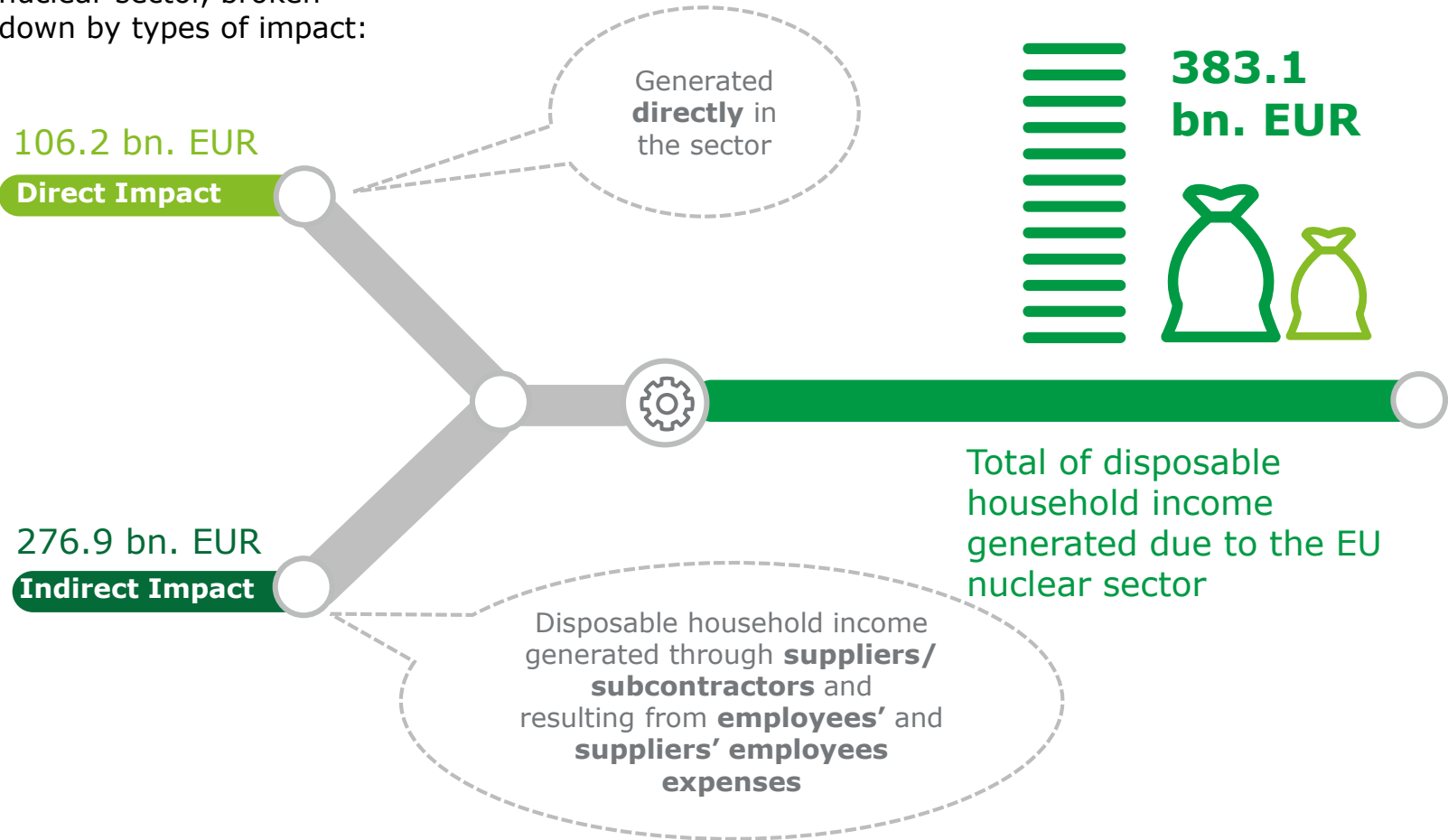


* includes operation in power plants and nuclear fuel cycle

C. Disposable household income

Every Euro of disposable household income generated due to the nuclear industry translates into a total impact of 3.6 Euro household income throughout the EU

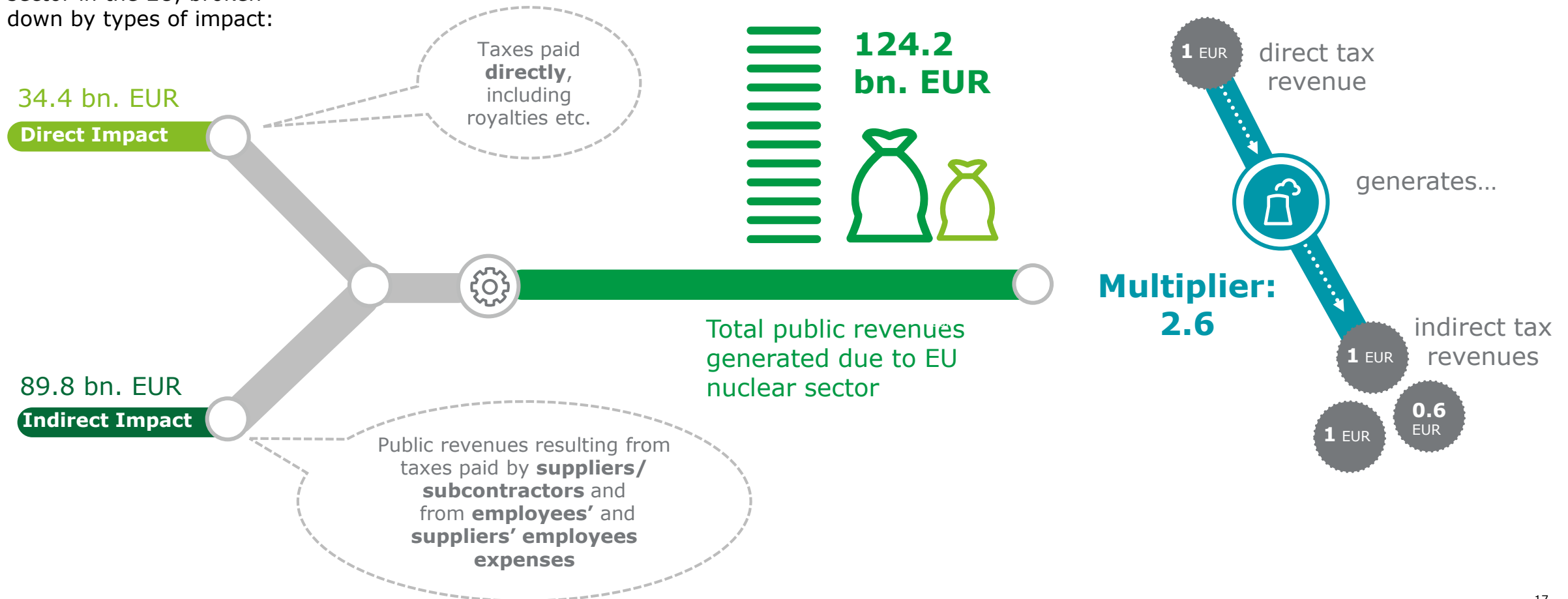
Disposable household income created through EU nuclear sector, broken down by types of impact:



D. Public revenues

Every Euro of tax revenues paid by the nuclear industry generates further indirect tax revenues of 2.6 Euro in the EU member states

Public revenues created through the nuclear sector in the EU, broken down by types of impact:

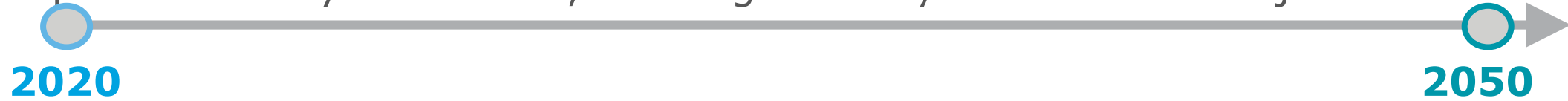


3.2 FUTURE IMPACT – HIGH SCENARIO

2020 – 2050

Overview of results

In a high capacity scenario, the nuclear sector will have a significant impact on the European economy as a whole, creating annually over 1.3 million jobs



575.9
bn. EUR

in **EU GDP** generated annually by nuclear sector,
equal to a **1.5 - 2%** share of EU GDP

1,321,600

average **number of jobs** generated and maintained
annually by the nuclear sector

45%

of the total number of **jobs in the nuclear sector will be**
highly skilled, equaling a number of **595,600**

490.9
bn. EUR

average disposable **household income** per year
due to the activities of the nuclear sector

110.2
bn. EUR

average **state revenues** generated annually through
tax payments deriving from the European nuclear sector

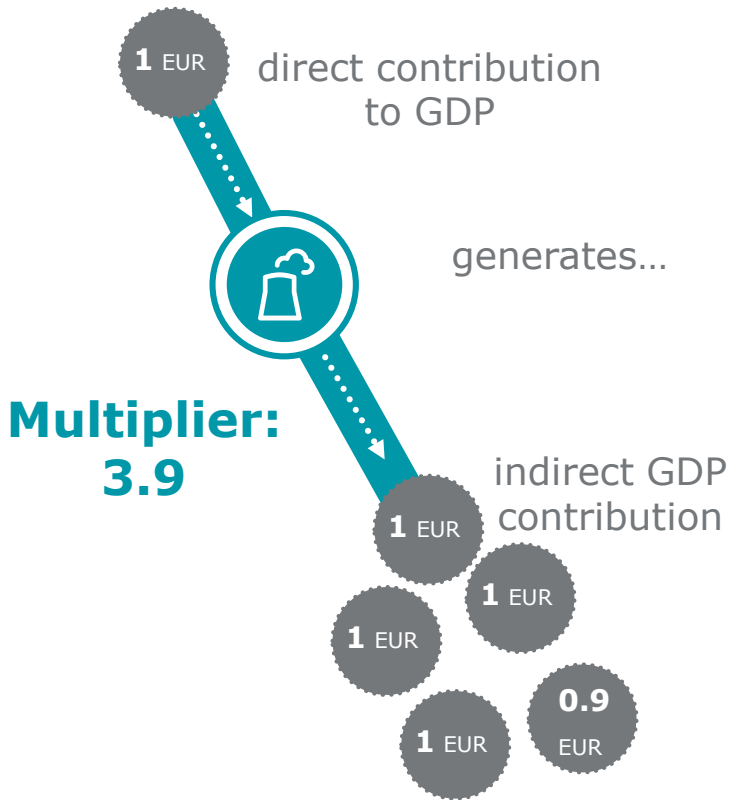
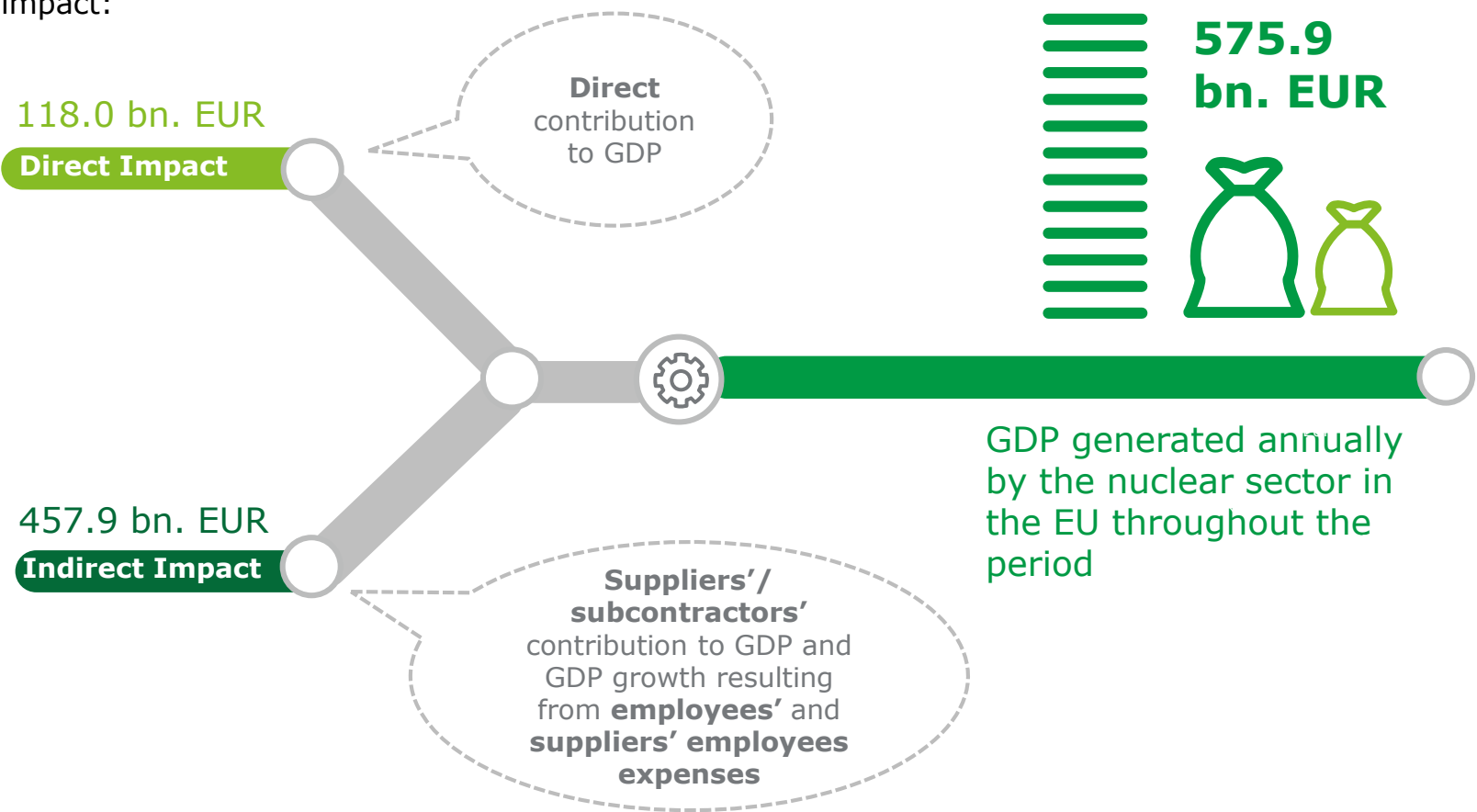
33.5
bn. EUR

average **trade surplus** generated annually within the
European nuclear sector

A. GDP Impact

Every Euro of the nuclear industry’s direct contribution to EU GDP will account for an additional contribution of 3.9 Euro, totaling an impact of 4.9 Euro in the EU GDP

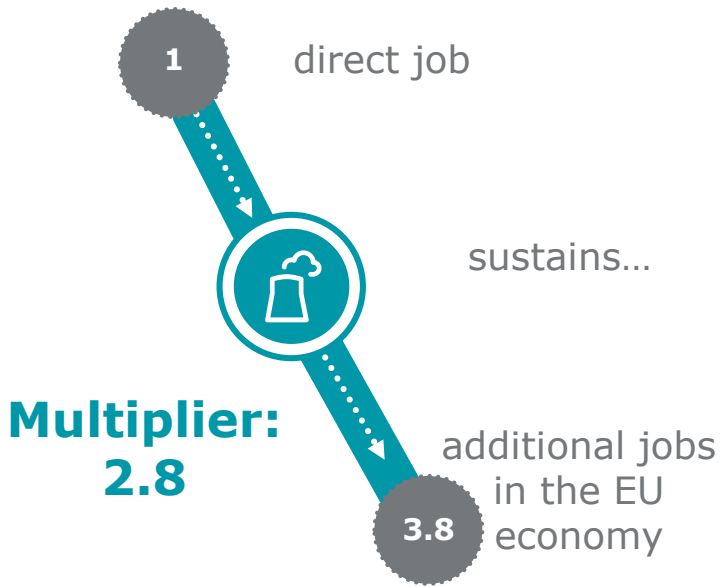
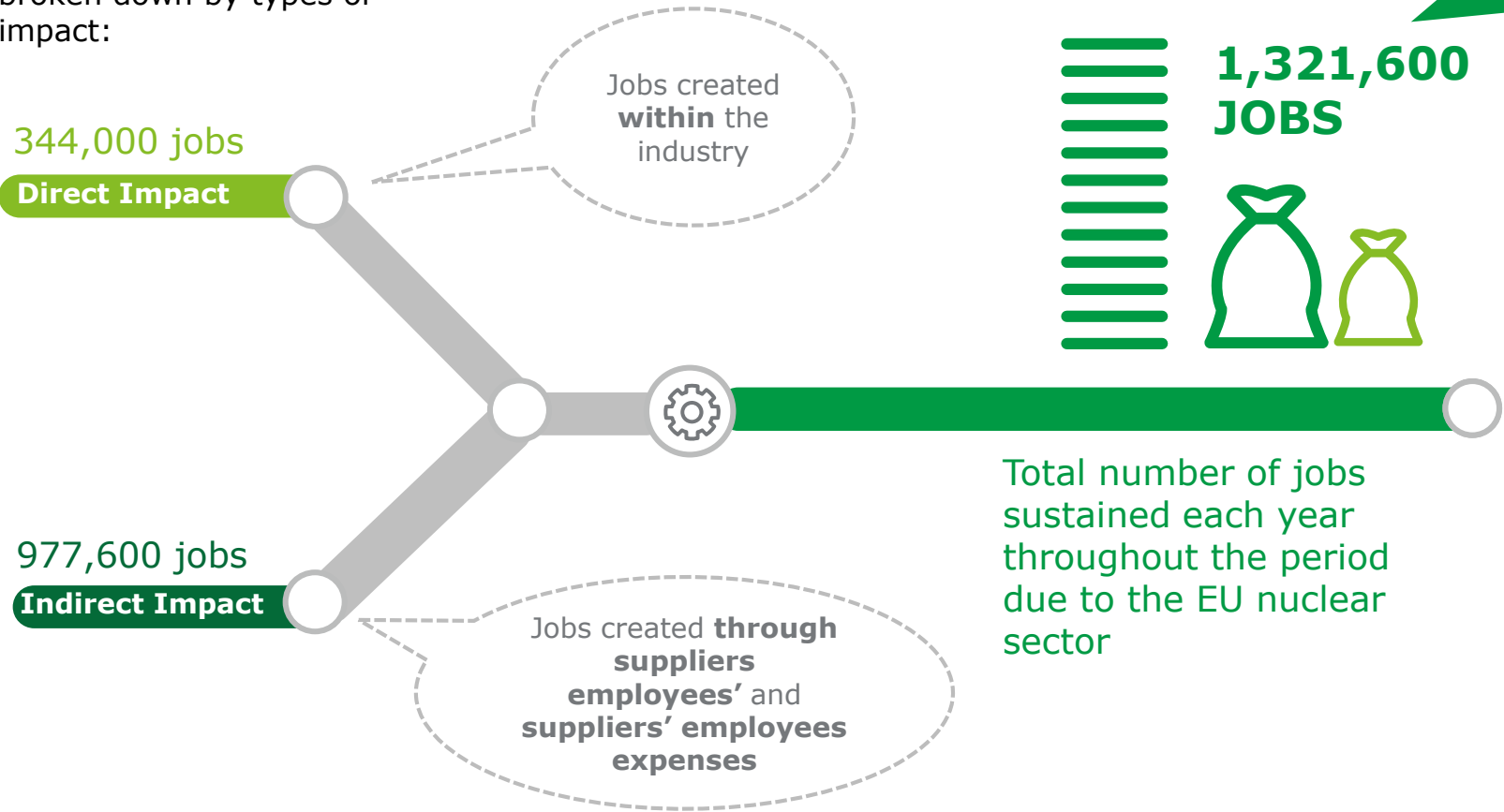
GDP generated through the EU nuclear sector, broken down by types of impact:



B.1 Job creation

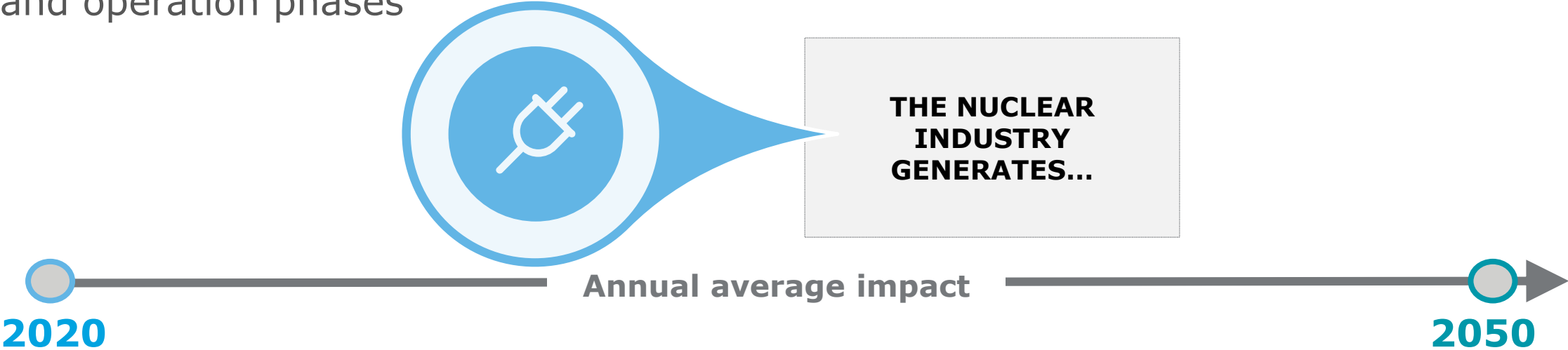
Every job created directly in the nuclear sector will sustain another 2.8 jobs on the EU labor force market throughout the period

Jobs created through the nuclear sector in the EU, broken down by types of impact:

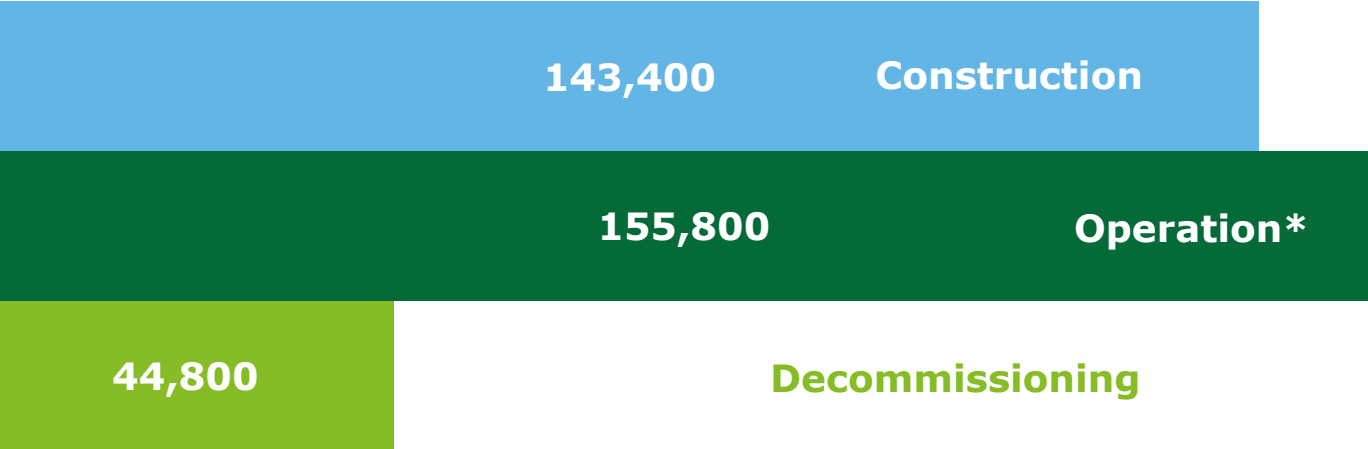


B.2 Job creation

In the future, there will be a nearly equal share of sustained direct jobs in construction and operation phases



344,000 direct jobs annually in power plants and the nuclear fuel cycle throughout the EU in the EU, out of which

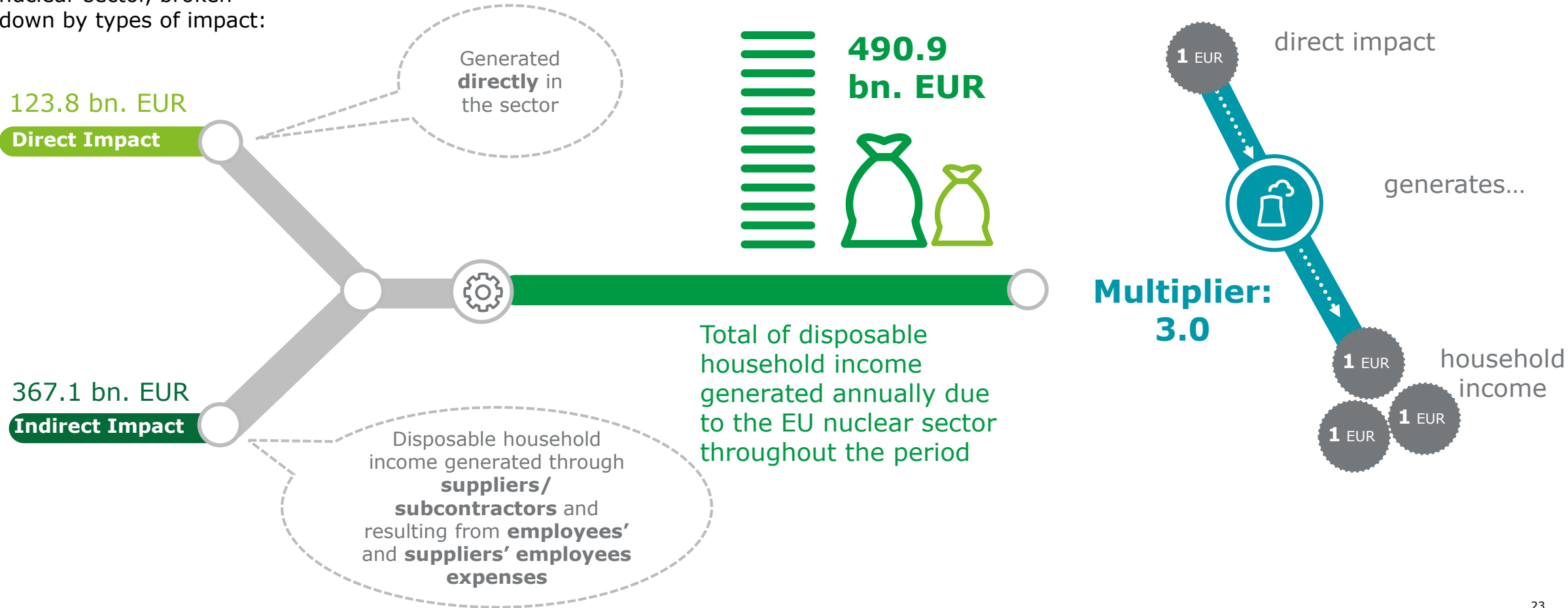


* includes operation in power plants and nuclear fuel cycle

C. Disposable household income

Every Euro disposable household income created due to the nuclear industry will generate further 3.0 Euro household income in the EU throughout the period

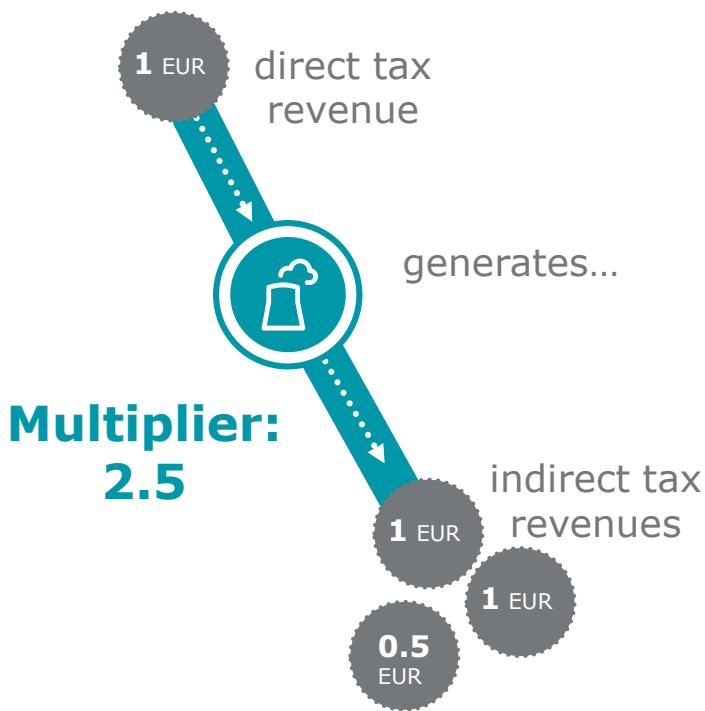
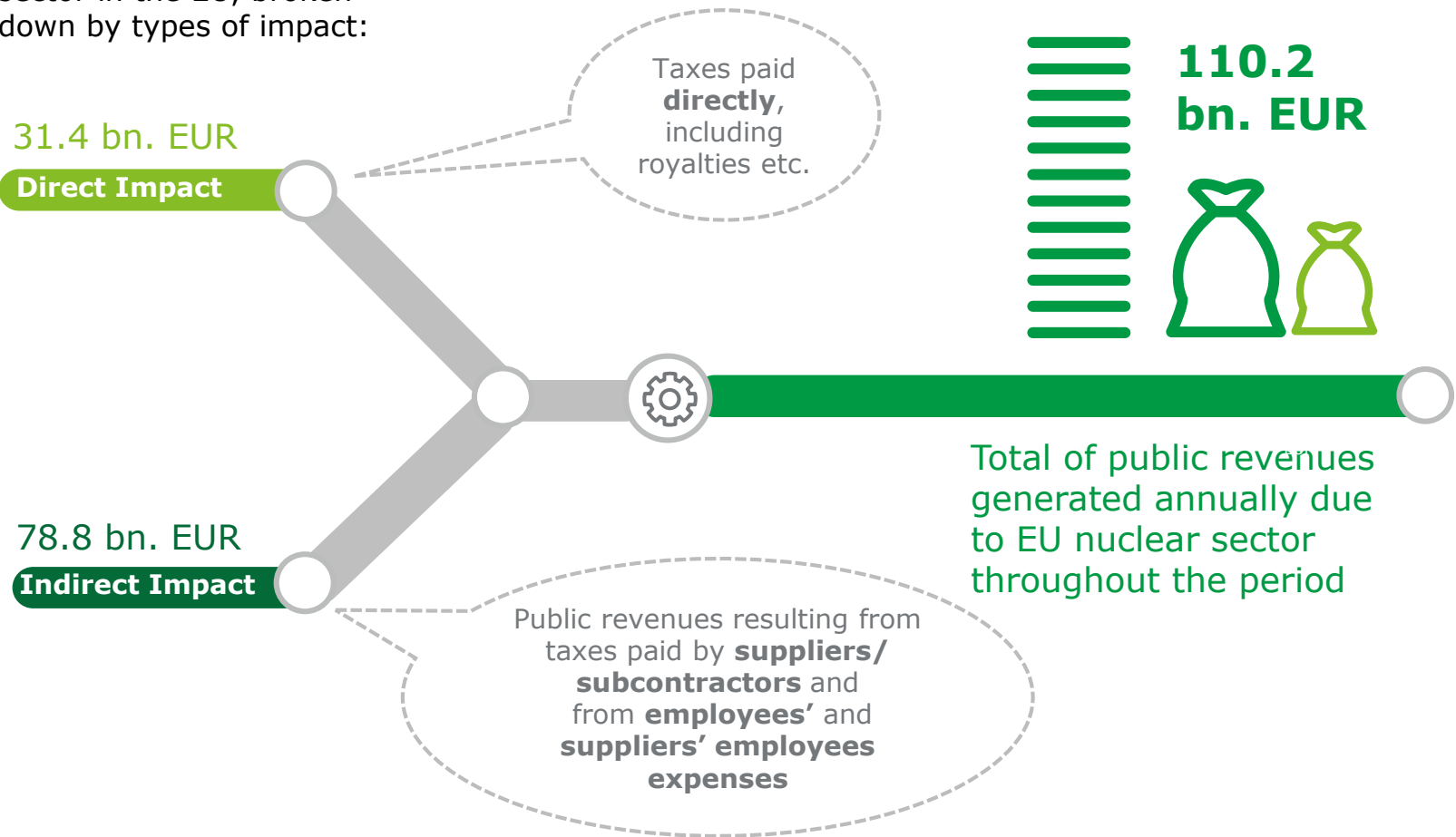
Disposable household income created through EU nuclear sector, broken down by types of impact:



D. Public revenues

Every Euro of tax revenues paid by the nuclear sector will generate indirect tax revenues of 2.5 Euro, totaling 3.5 Euro total public revenues in the EU member states

Public revenues created through the nuclear sector in the EU, broken down by types of impact:

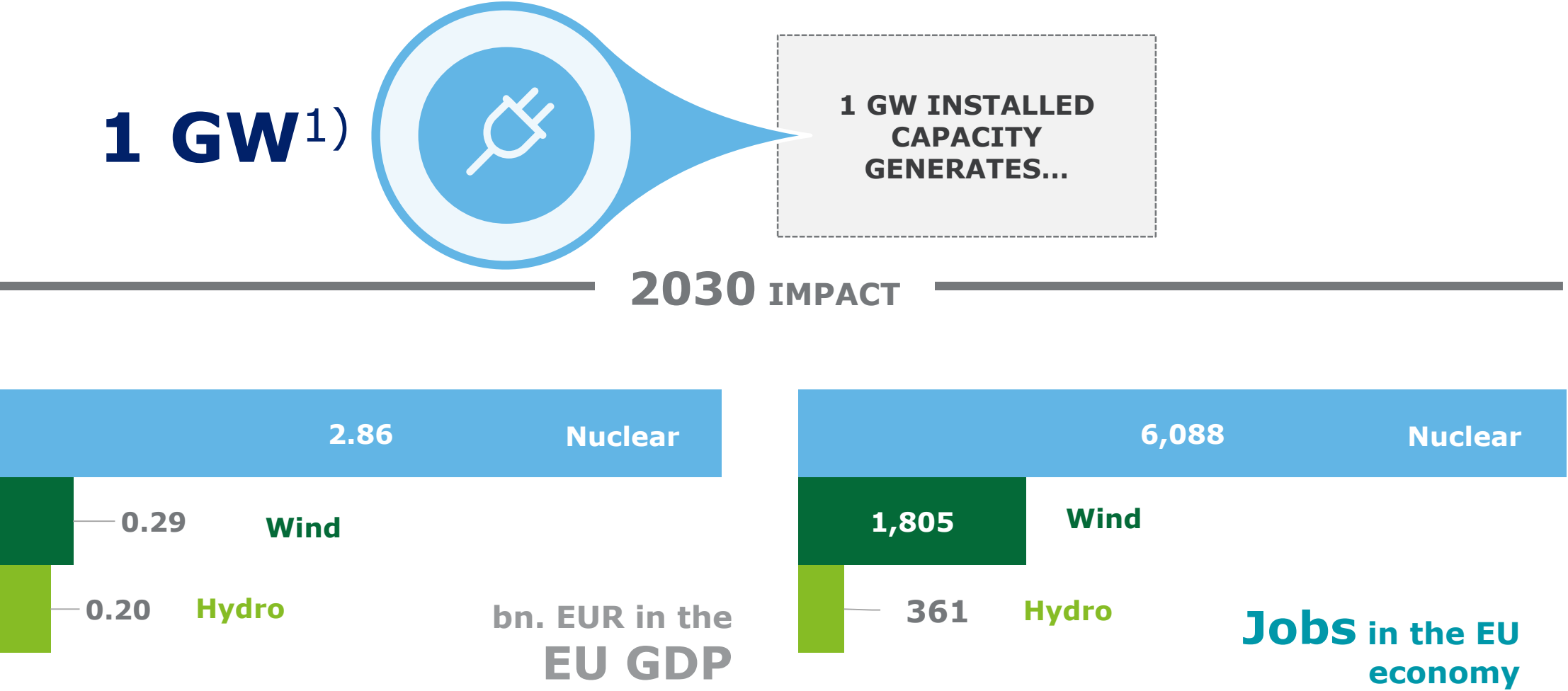


3.3 COMPARISON WITH OTHER SECTORS

CURRENT | 2030 | 2050

Impact of nuclear, wind and hydro industries on the EU economy

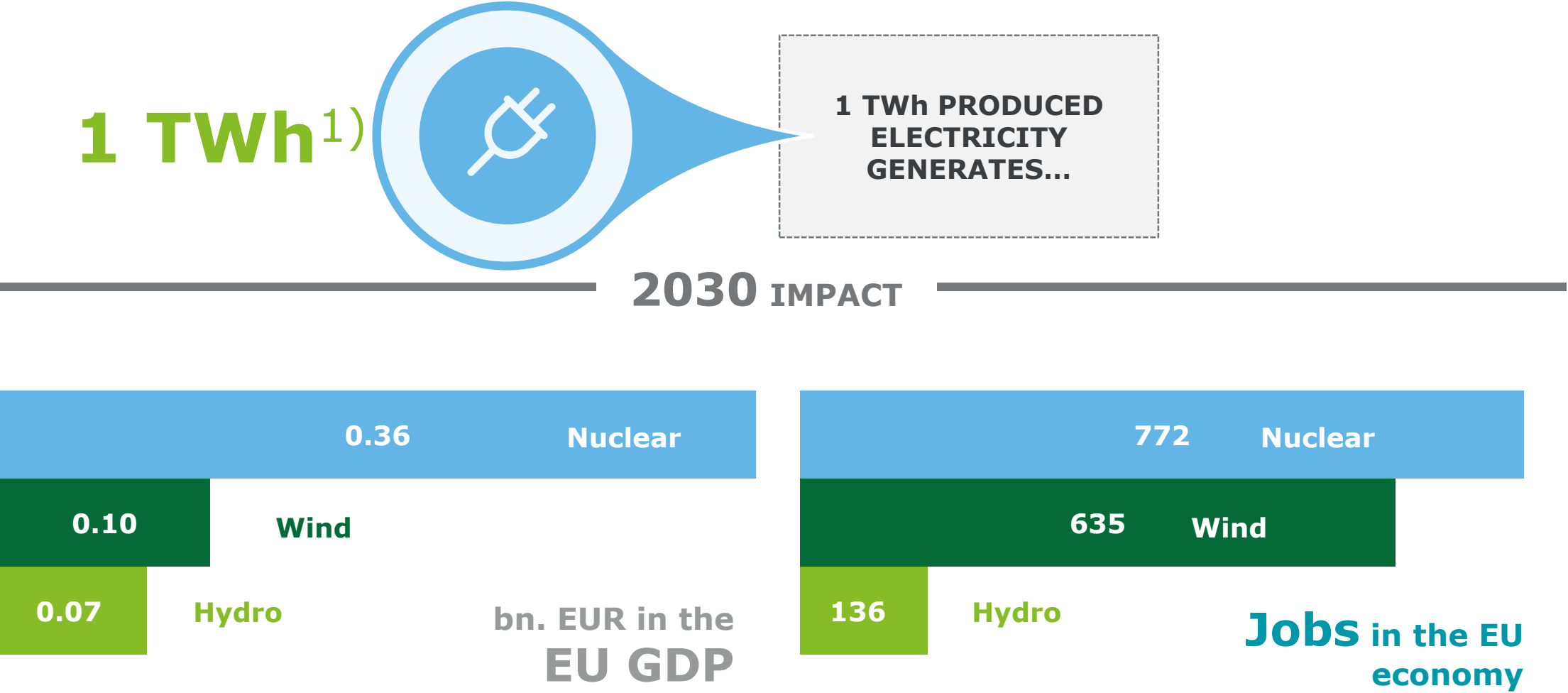
The nuclear sector provides more jobs per installed GW and has a larger impact on the GDP than the other two clean energy sectors



¹⁾ With capacities of 128.5 GW (Nuclear), 397 GW (wind) and 263 GW (hydro) in 2030

Impact of nuclear, wind and hydro industries on the EU economy

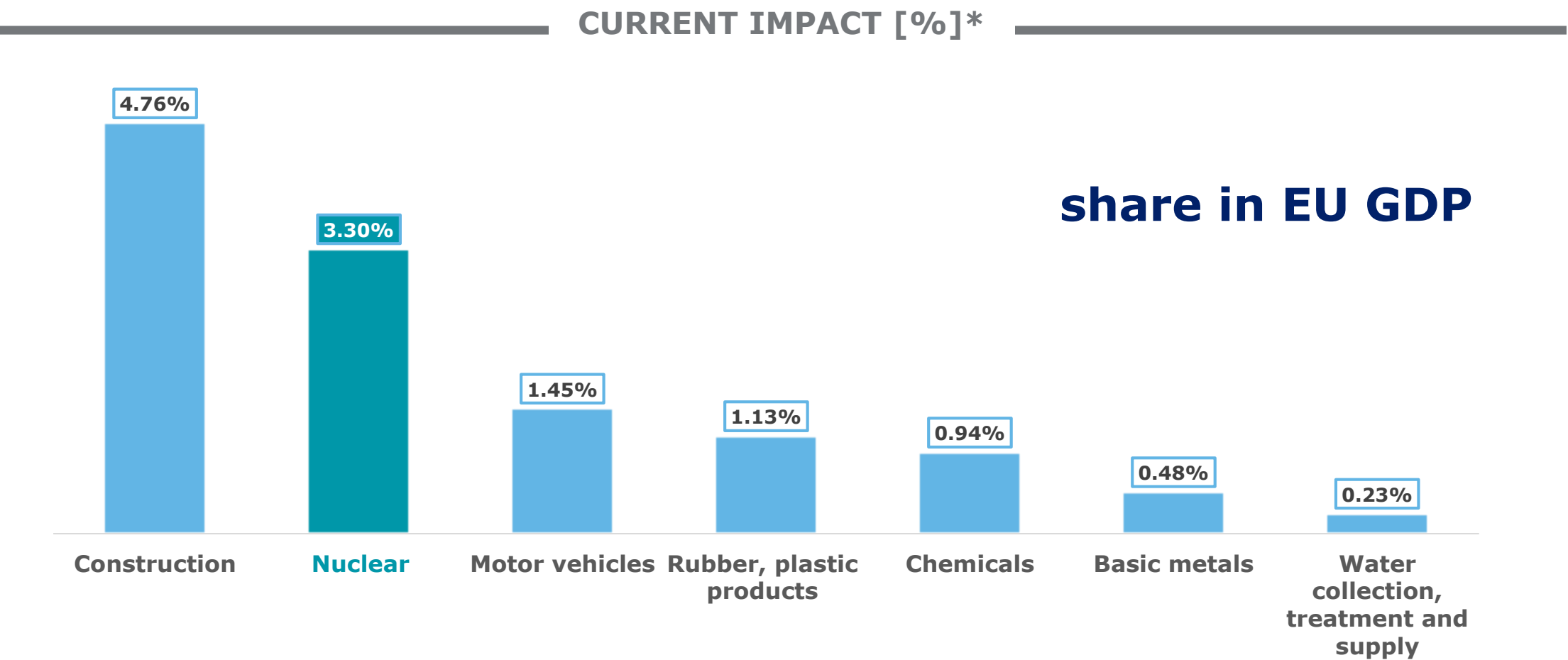
The nuclear sector provides more jobs per installed GW and has a larger impact on the GDP than the other two clean energy sectors



¹⁾ Electricity generation 1,013 TWh (Nuclear), 1,129 TWh (wind) and 700 TWh (hydro) in 2030

Share of the nuclear industry and other economic sectors in the EU GDP

The nuclear sector has a significant current share in EU GDP, compared to other economic sectors

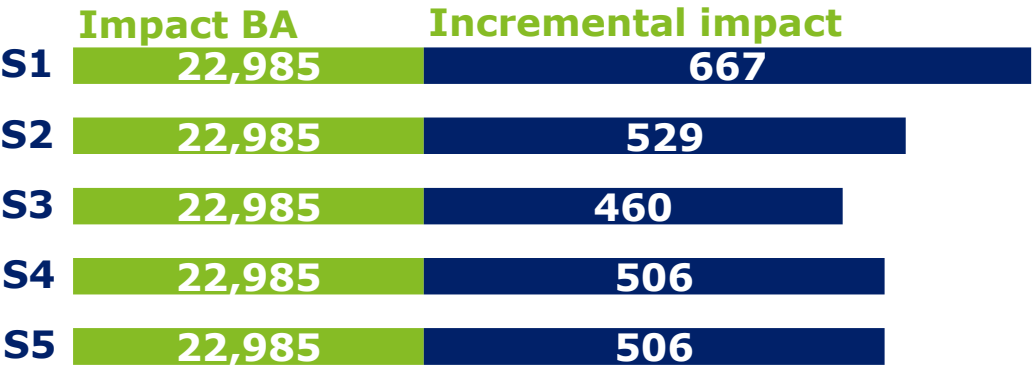


* Current impact depicts share in EU GDP in 2019 for the nuclear industry and in 2016 for the other economic sectors

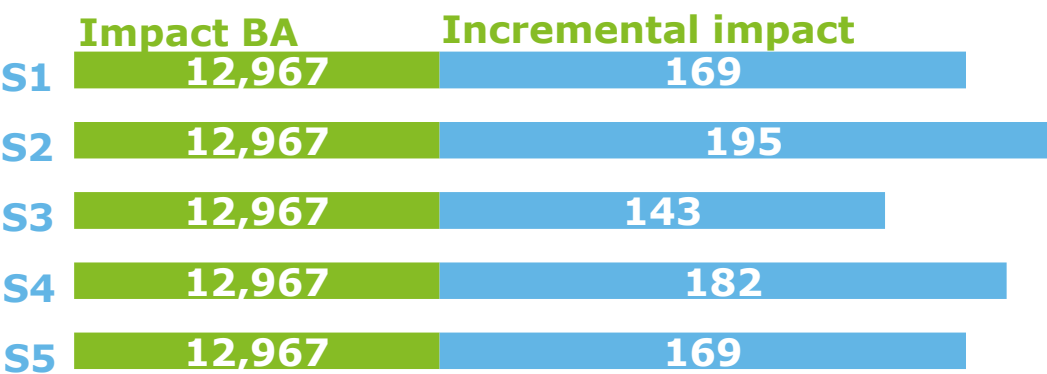
Impact in the six different scenarios deployed in the EC 2013 study
Compared to S3 with high RES share, S2 and S4 scenarios have bigger impact on GDP, consumer expenditures and investments

2050 IMPACT [bn. EUR]

Impact on GDP



Impact on Expenditures



BA (Baseline scenario) considers policies and measures adopted until March 2010, implies the achievement of 2020 targets (RES and GHG emissions).

S3 implies additional measures for achieving a high overall RES share and higher use of renewable sources in power generation.

S1 implies energy efficiency measures such as standards for household appliances, new buildings and electricity generation.

S4 is similar to S2, but implies constraints for CCS. Assumptions for nuclear energy are similar to the ones from S1 and S2.

S2 implies diversified supply technologies and foresees no support measures for energy efficiency and RES. Also, there are no constraints for nuclear and CCS.

S5 is similar to S2, but implies constraints for nuclear energy. Assumptions for CCS are similar to the ones from S1 and S2.

The **contribution of the energy sector to the overall EU economy** in Scenarios **S2** and **S4** (high nuclear) is higher compared to S3 (high RES).*

*This proves once more the **importance of the nuclear technology** in the future energy system of the EU.*

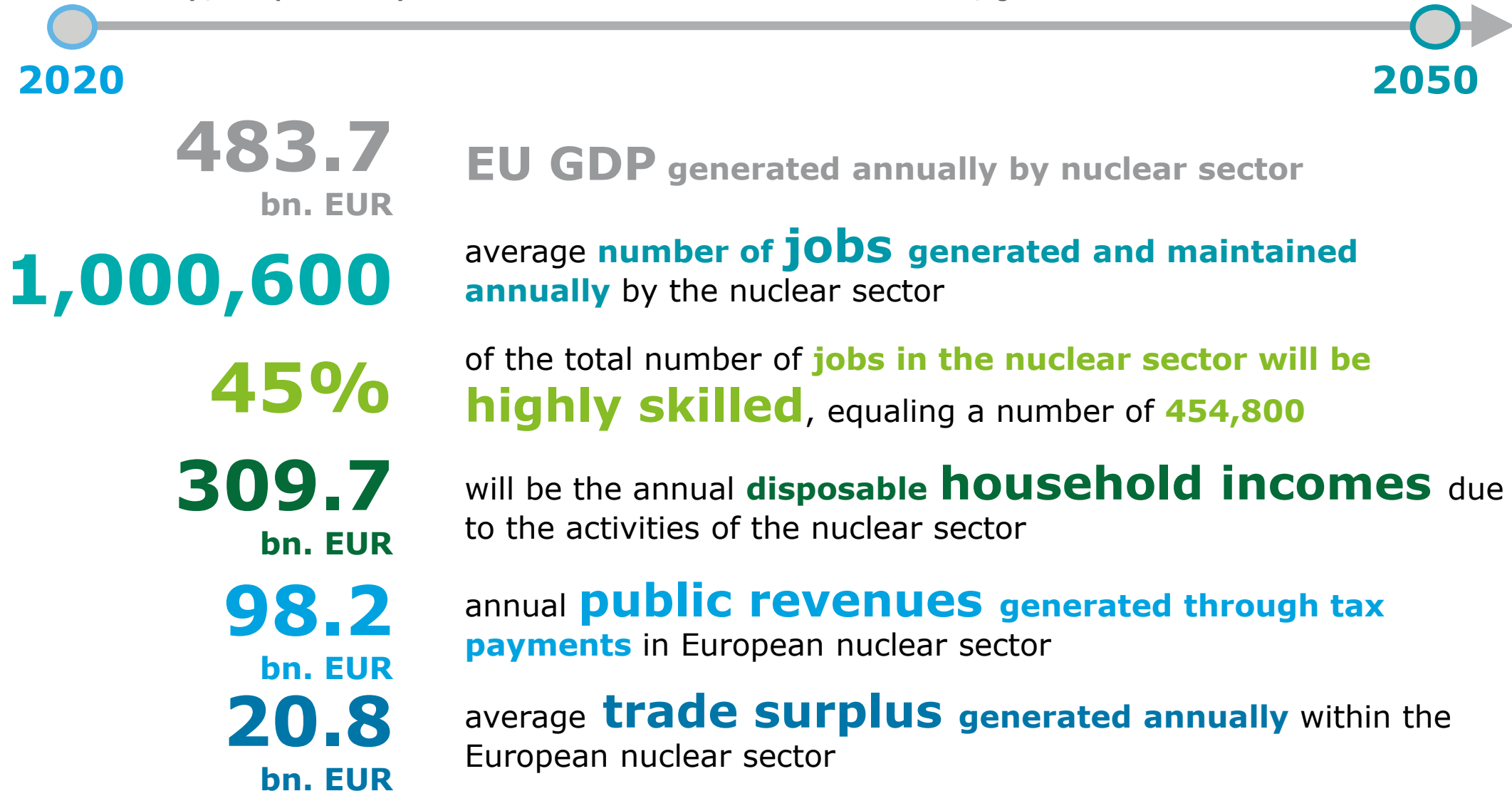
* Results are taken from the study *Employment Effects of selected scenarios from the Energy roadmap 2050*, conducted for the European Commission by Warwick Institute for Employment Research, Cambridge Econometrics, Exergica, Ernst&Young, E3M-Lab. 2013

3.4 FUTURE IMPACT – MEDIUM SCENARIO

2020 – 2050

Overview of results

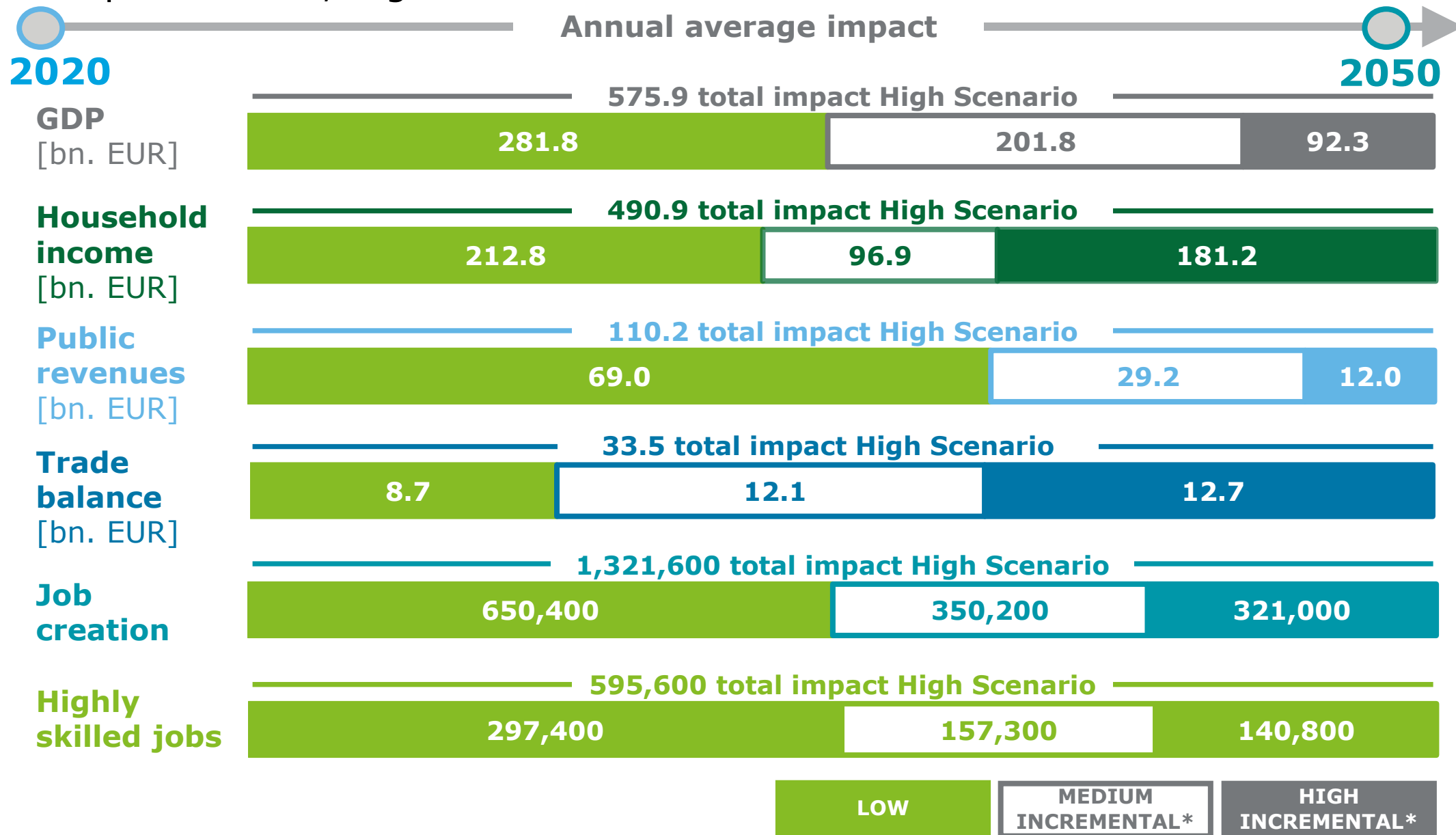
In the Medium Scenario, the nuclear sector will have a significantly lower impact on the EU economy, especially in terms of GDP contribution, job creation and investments



3.5 COMPARISON OF NUCLEAR IMPACT SCENARIOS

2020 – 2050

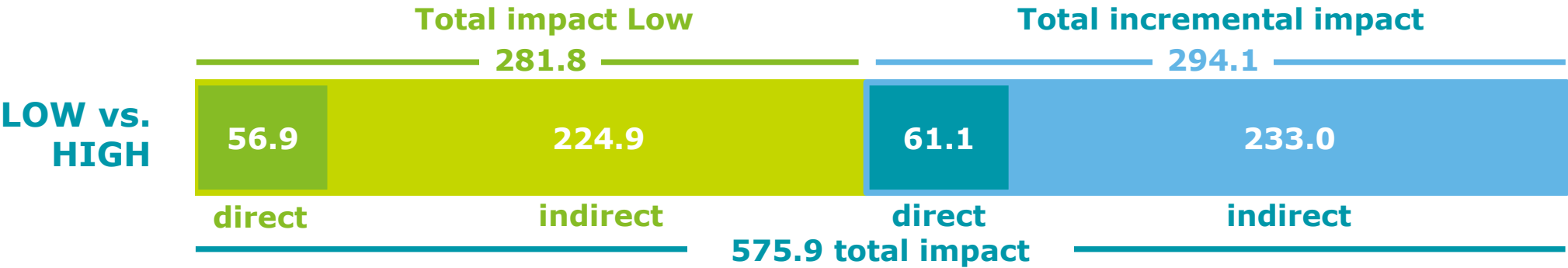
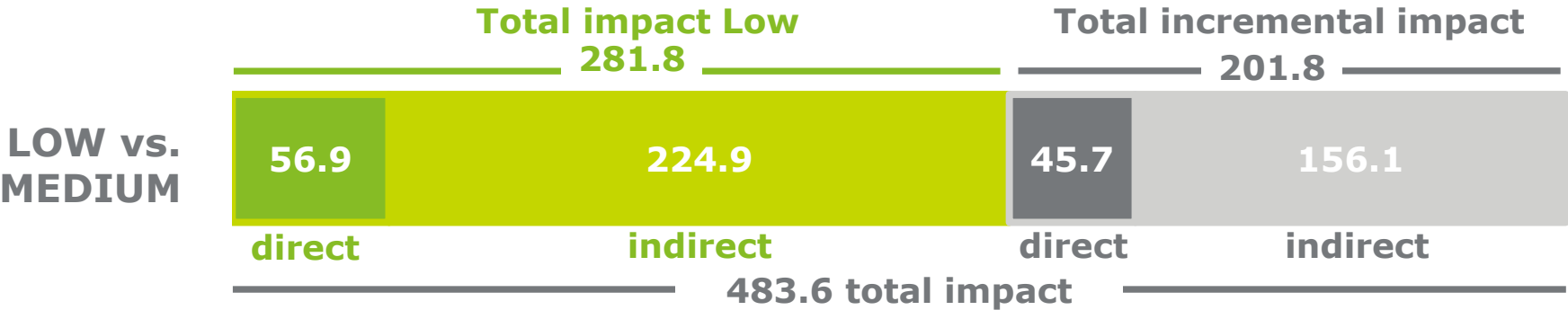
Comparison Low, High and Medium Scenario



* incremental annual impact compared to Low

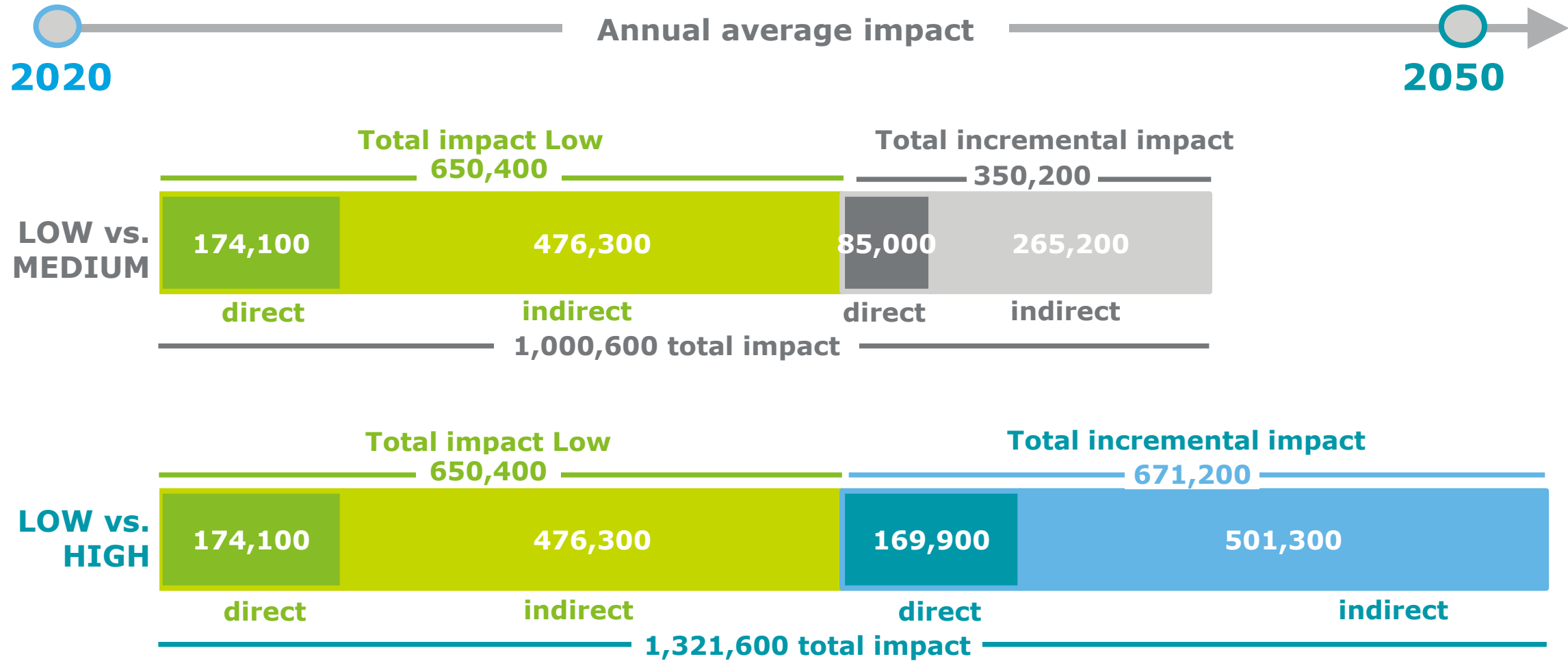
A. GDP

The deployment of the High Scenario would entail an incremental impact on GDP of nearly 9 trillion Euro in the course of the next 30 years, being added to Low



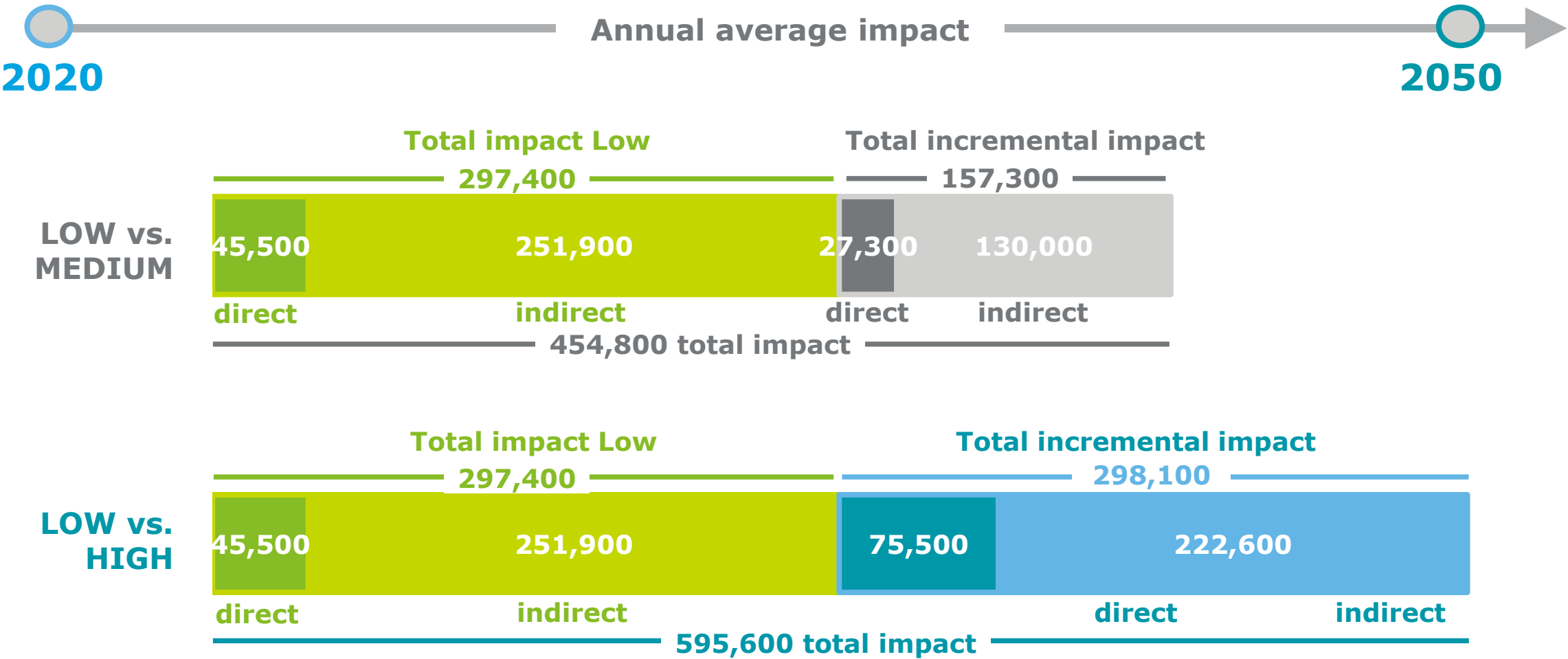
B. Job creation

The nuclear industry could account for a total of 39.6 million jobs during the upcoming 30 years, if the High Scenario was deployed



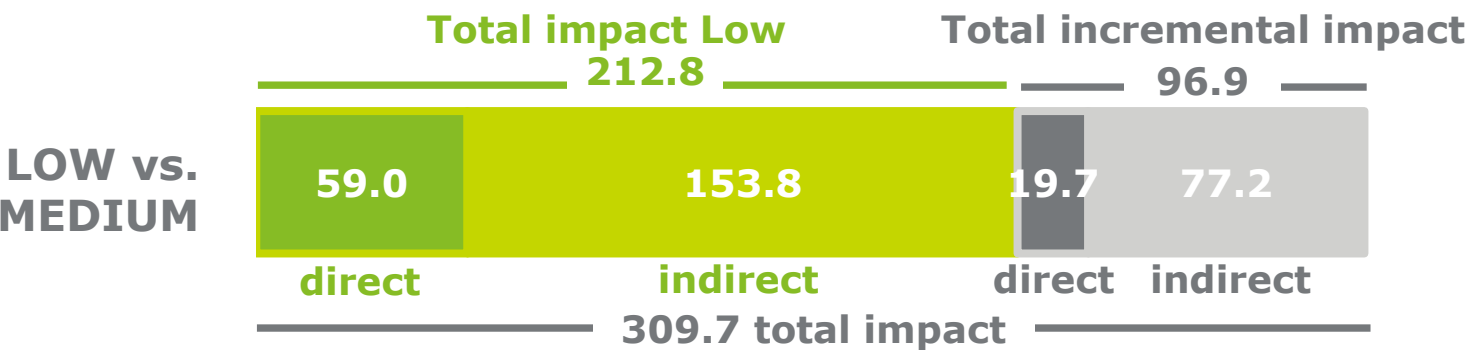
C. Highly skilled jobs

In the High scenario, overall 18 million highly skilled professionals could be employed by the nuclear industry throughout the period 2020 - 2050



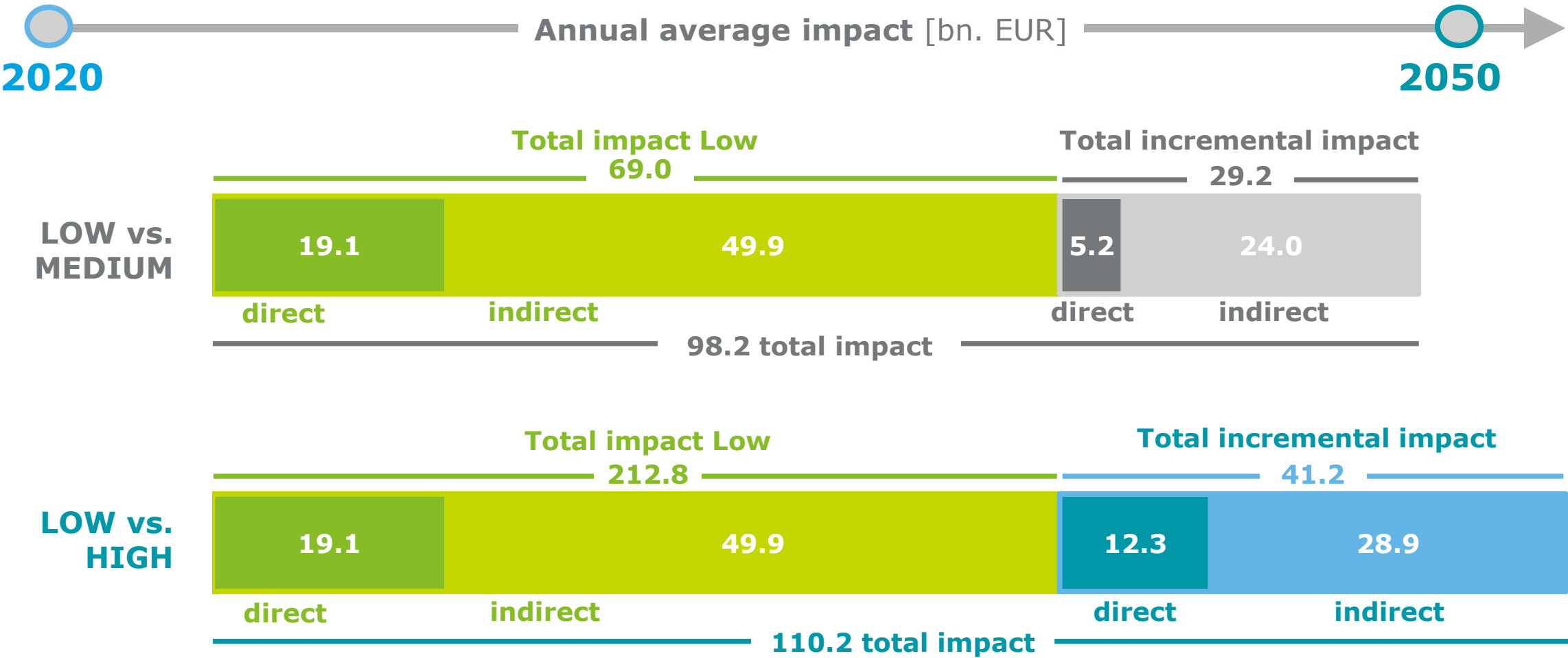
D. Disposable household income

In the High Scenario, the incremental impact on EU household incomes would amount to 2.9 trillion Euro in the period 2020 – 2050, being added to Low Scenario



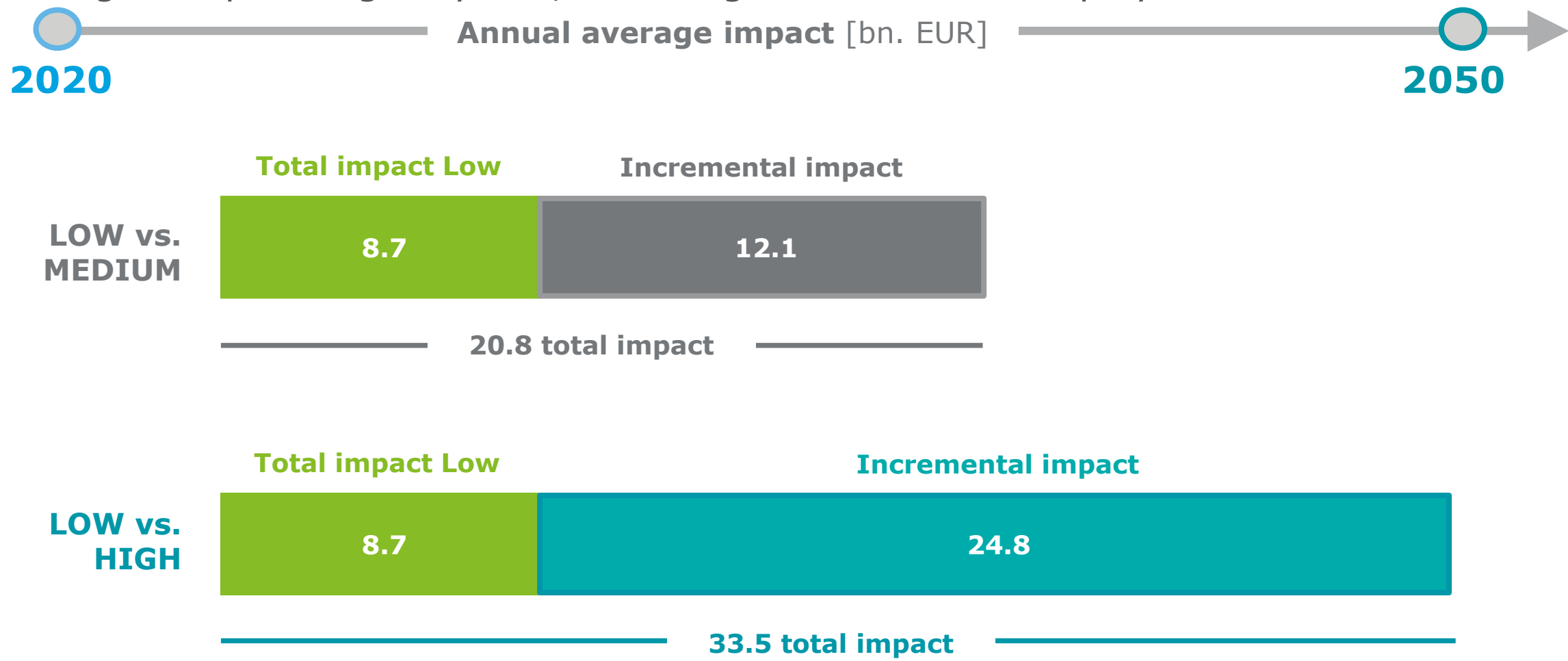
E. Public revenues

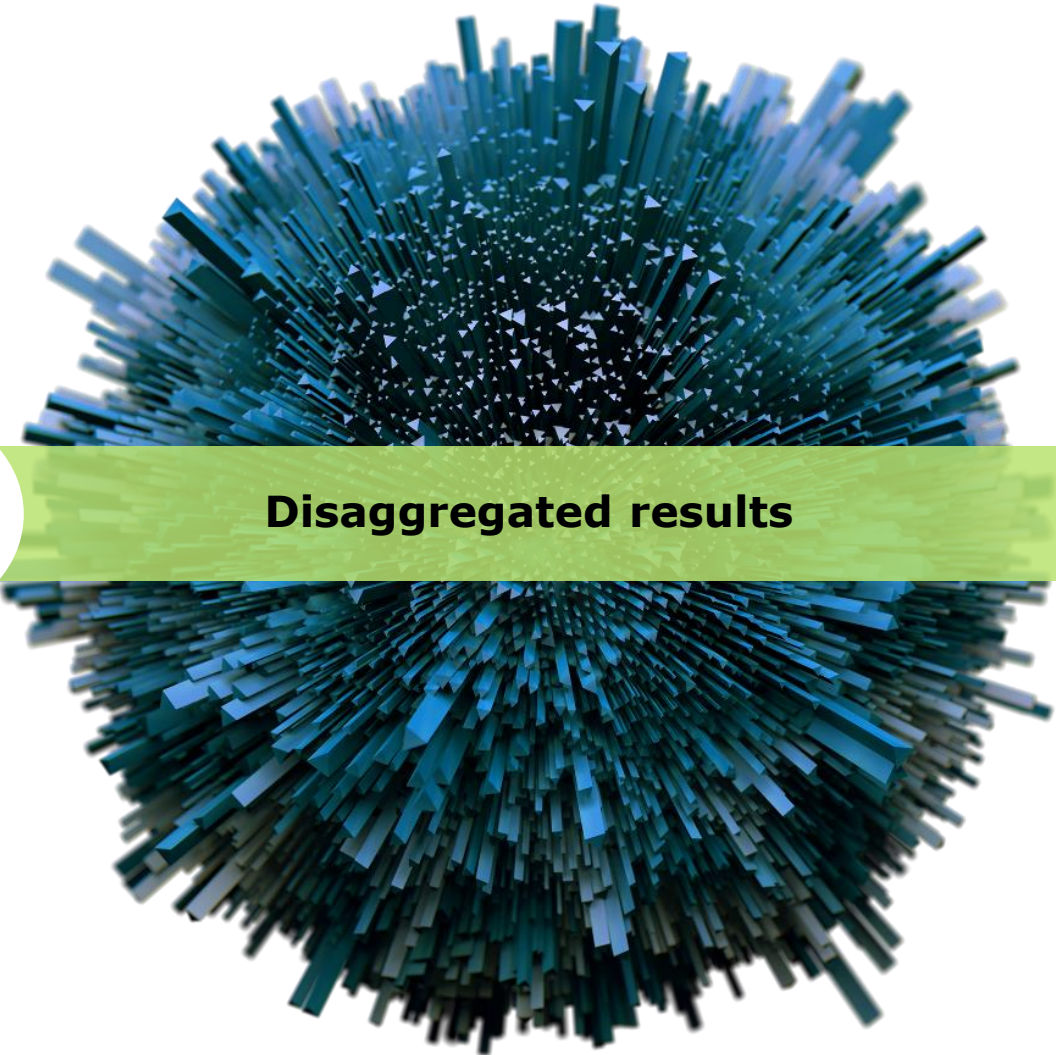
In the High Scenario, the nuclear industry will account for a cumulated impact of 3.3 trillion Euro public revenues throughout the EU during the period 2020 - 2050



F. Trade balance

Due to the nuclear industry, the trade surplus of the EU could raise by 1 trillion Euro during the upcoming 30 years, if the High Scenario was deployed



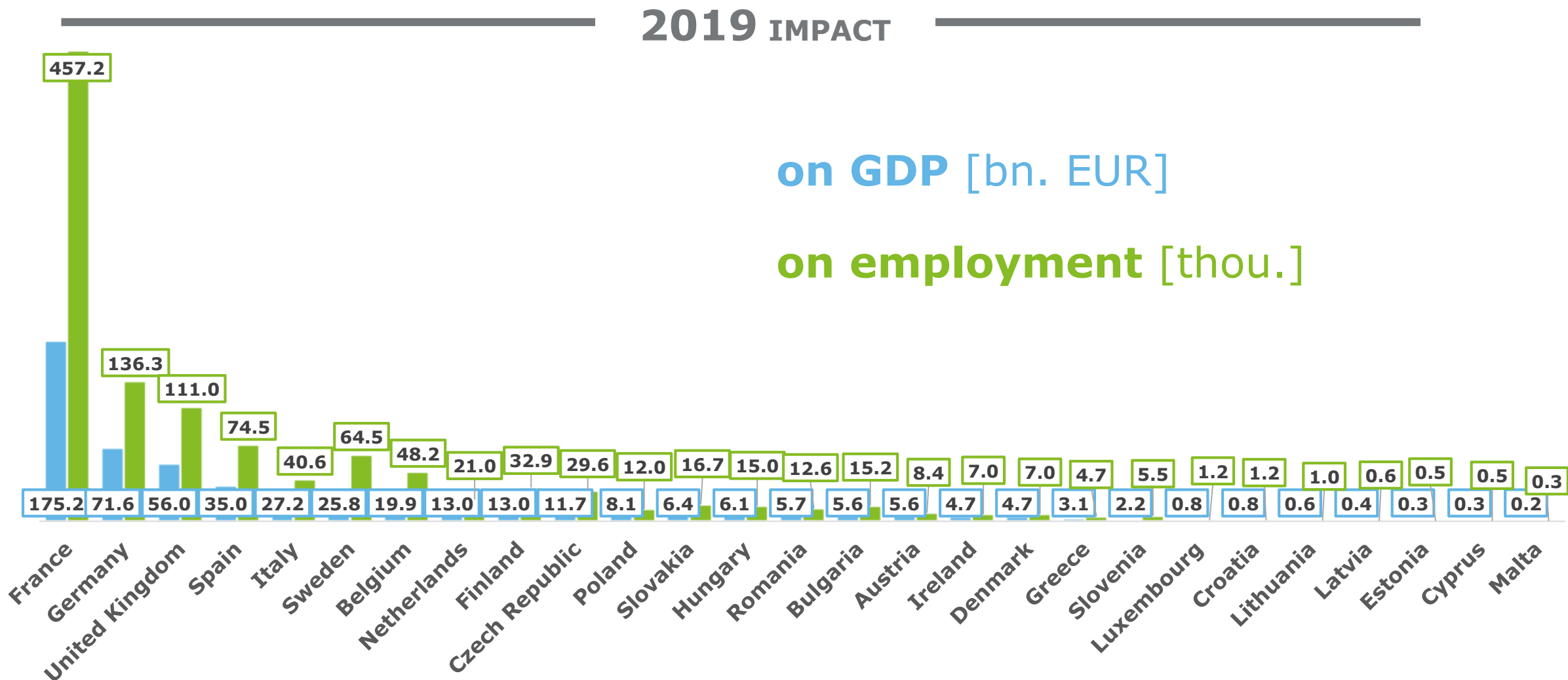


4

Disaggregated results

Impact on GDP and disposable household income

The impact of the nuclear industry on GDP and household income in countries without nuclear is still perceivable, due to cross border exchange of labour force





Disclaimer

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Deloitte was requested to undertake the work based on its own resources and expertise, as well as publicly available information. Deloitte work excludes taxation, legal, accounting, auditing, technical, environmental protection and any industry, corporate or other type of specialized matters. Therefore, the Study may not be suitable for any purpose other than the purpose set out herein.

Deloitte prepared and delivered the Study on the basis that it is for FORATOM’s benefit and information. Accordingly, Deloitte does not accept or assume responsibility to any party other than FORATOM in connection with this Report, for any judgments, findings, conclusions, recommendations or opinions that Deloitte has formed or made. Should any third party choose to rely on or refer to this Analysis, they do so by their own responsibility.

Our Analysis is meant to be a reasonable, objective starting point for rationally discussing the economic benefits of potential nuclear power generation activities and developments.

Before taking any action that relies on the information included in this Study, consultation of competent professional legal or other relevant assistance has to be assured. Decisions based on the information presented in this Study are the sole responsibility of the party who takes that decision.

The information contained herein is of a general nature, not intended to address the circumstances of any particular individual or entity. It does not aim to provide an analysis of relevant legal matters and circumstances nor is it based on professional legal counsel. Although we endeavour to provide accurate and up-to-date information, we do not guarantee that such information is accurate as of the date of reception or that it will continue to be accurate in the future.

The information contained in this Study is selective and can be subject to update, expansion, revision and amendment. It does not claim to contain all of the information that any interested third party may require. Any statements, estimates and forecasts contained in this report reflect various assumptions of the expected results, assumptions that may or may not prove to be correct.

The input data was collected from publically available sources and Deloitte’s own private data and panels of experts, while the forecasts have been projected based on the historical data and our assumptions regarding the evolution of the nuclear industry.

The contents, analyses and conclusions contained in this Report do not necessarily reflect the individual opinions of the participating experts. A wide range of sometimes opposing viewpoints and opinions were expressed, which made it possible to study in greater depth and contrast the fundamental issues covered by the Study. A comprehensive overview of the methodology and statistical sets of data employed by the authors is available in the Appendix of the document.

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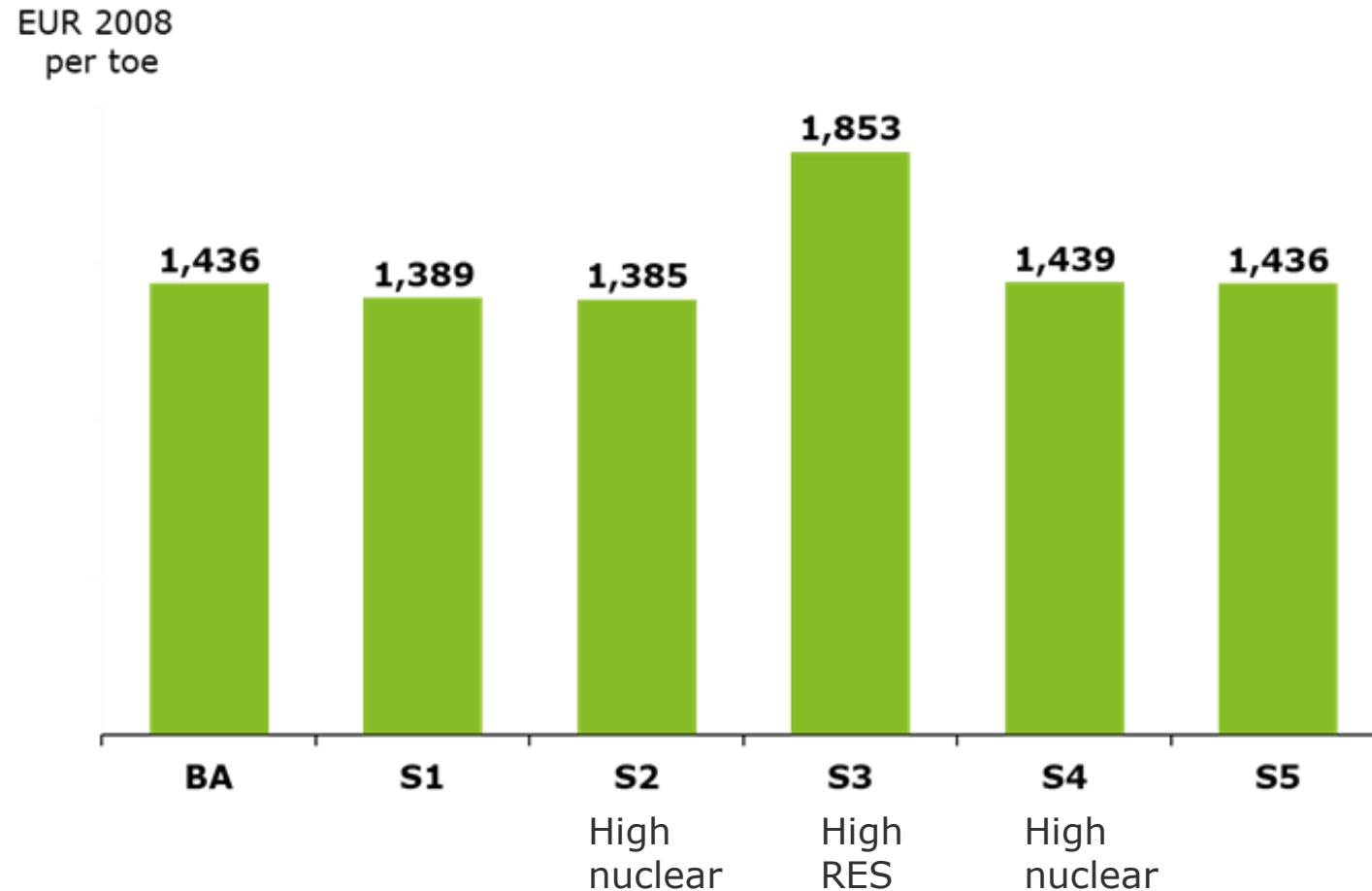


5

Backup

Electricity prices – EC 2013 study*

Differences between the six scenarios from the study conducted in 2013 for the European Commission concerning the employment effects of energy roadmap 2050 alternatives



* Prices are taken from the study *Employment Effects of selected scenarios from the Energy roadmap 2050*, conducted for the European Commission by Warwick Institute for Employment Research, Cambridge Econometrics, Exergia, Ernst&Young, E3M-Lab. 2013