Deloitte.

Economic and Social Impact Report

Nucleareurope

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Content

List of tables

List of figures

List of acronyms

AGR	Advanced Gas-cooled Reactor
Bn.	Billion
BWR	Boiling Water Reactor
CAPEX	Capital Expenditure
Client	Nucleareurope
GDP	Gross Domestic Product
GW	Gigawatt
Deloitte	Deloitte Consultanta SRL
EC	European Commission
EU	European Union
ESA	Euratom Supply Agency
EUR	Euro
EURATOM	European Atomic Energy Community
IAEA	International Atomic Energy Agency
IEG	Industrial Electrical Group
ISL	In Situ Leach Mining
ISCO	International Standard Classification Of Occupations
LTO	Long Term Operation
LWR	Light Water Reactor
Mil.	Million
MOX	Mixed Oxide
MW	Megawatt
MWe	Megawatt Electrical
PINC	Nuclear Illustrative Programme
PHWR	Pressurized Heavy Water Reactor
Ppm	Parts Per Million
Pu	Plutonium
PWR	Pressurized Water Reactor
SCWR	Supercritical Water Reactor
SMR	Small Modular Reactor
Thou	Thousand
TWh	Terawatt-hour
U	Uranium
VAT	Value Added Tax

The socio-economic impact evaluation of the Nuclear Industry on the European Union has been carried out using the "input-output" methodology and Deloitte´s approaches, which evaluate the direct indirect and induced effects of the nuclear industry in the EU economy.

I. Executive Summary

Key findings

A #200GW nuclear power capacity would entail widespread economic benefits throughout the EU-27, sustaining almost two million jobs and hundreds of billions of Euro in additional economic output, tax revenues and household income. The table below presents a summary of the current and future economic benefits. The first column indicates the present situation of the EU nuclear industry as of 2023, with an installed capacity of 106 GW. The table below provides the current and potential outcomes of the analysed scenarios.

In the future, the nuclear industry could sustain **more than 1.6 million jobs** each year throughout the period in the EU

Table 1 - Summary of scenarios and economic benefits in 2023 and throughout the period 2025 - 2050

Annual economic benefits*	2023	2025 - 2050		
		#100GW	#150GW	#200GW
Impact on economic output [bn. EUR]	251.2	240.5	330.3	383.0
Disposable household income [bn. EUR]	38.0	37.2	51.0	59.3
Public revenues [bn. EUR]	47.6	45.2	61.6	71.9
Total jobs [no. of jobs/year]	883,700	1,050,000	1,477,000	1,667,600

**Includes direct, indirect and induced impact, as resulted from applying the input output methodology, described in the Appendix – figures represent yearly average for the analysed period.*
Source: Deloitte analysis

Currently, the nuclear sector contributes with an impact on EU's economic output amounting to 251.2 billion Euro per year and generates yearly public revenues of about 47.6 billion Euro. Moreover, due to the nuclear sector, more than 883 thousand jobs are sustained each year throughout the period for European citizens. In 2023, the disposable household income materialized due to the nuclear industry amounts to 38.0 billion Euro.

In the #200GW Scenario, more than 1.6 million jobs would be sustained each year throughout the period on the EU labour force market. In the period 2025 – 2050, the sector would significantly contribute to the EU economic growth, generating on an annual basis an impact on economic output of 383.0 billion Euro, an additional tax revenue of 71.9 billion Euro and a disposable household income of 59.3 billion Euro.

The deployment of the #200GW Scenario would entail a **significant increase of EU economic output** by **142.5 billion Euro** compared to the **#100GW** scenario, summing up to an additional impact of **3.6 trillion Euro** over the entire period of analysis

The incremental economic benefits arising from the deployment of a #200GW Scenario in comparison to the #100GW Scenario would be widespread. For instance, through the deployment of the #200GW Scenario, the nuclear industry would generate an annual economic impact of €142.5 billion in EU economic output under the #200GW Scenario compared to the #100GW Scenario. In other words, the overall incremental impact of the #200GW Scenario on EU economic output would rise to 3.6 trillion Euro throughout the timespan 2025-2050.

The table below presents a summary of the incremental impacts (annual average) of the #200GW and #150GW Scenario, compared to the #100GW Scenario.

Table 2 - Summary of annual incremental benefits in #150GW and #200GW Scenario, compared to #100GW Scenario

Annual incremental benefits* compared to #100GW Scenario	2025 - 2050	
	#150GW	#200GW
Impact on economic output [bn. EUR]	89.8	142.5
Disposable household income [bn. EUR]	13.8	22.1
Public revenues [bn. EUR]	16.5	26.7
Total jobs [average no. of thousand jobs/year]	427	618

** Figures represent the annual incremental benefits, including direct, indirect and induced impact for #150GW and #200GW Scenario, compared to #100GW Scenario for the analysed period 2025-2050.*

Source: Deloitte calculations

The differences between the #150GW and #200GW Scenarios should be assessed considering the multiplication factor derived from the increased installed energy capacity for baseload generation and the timing of commissioning new capacities[1]. Consequently, the #200GW Scenario improves the electricity price available to EU industries, enhancing goods manufacturing (including nuclear supply chain) efficiency, job creation and disposable household income.

Objectives and acknowledgements

For more than 60 years already, nuclear energy has been a reliable source of electricity in the European countries. In 1957, the *Euratom Treaty* established the *European Atomic Energy Community (Euratom)* and since then, the nuclear industry has had a significant contribution to the Union's economic growth, enhancing security of supply on the continent. Nowadays, as the commitment for a climate-neutral economy by 2050 is one of the key policy objectives of the Union, the contribution of nuclear power could become an indispensable prerequisite for achieving the ambitious GHG emissions reduction targets. Thus, nuclear energy is considered[2] one of the key instruments for a sustainable, competitive and secure energy system in 2050, as set out in the Mario Draghi's report "A competitiveness strategy for Europe".

The aim of the present study is to analyse the contribution of the nuclear power sector to the overall economy of the European Union. It will assess current economic and social benefits generated directly through the nuclear industry and effects resulting from the nuclear sector's economic activities throughout the EU-27. The analysis was conducted to show both the current impact of the industry and provide a measurable outlook on its future benefits up to 2050. The areas of the EU-27 economies analysed in the impact assessment are impact on economic output, job creation, disposable household income and public revenues.

The methodological fundament of the present study is the "input output" methodology, a macroeconomic analysis based on the interdependencies between different economic sectors or industries. The model is generally used by international bodies such as the

1 There are differences between scenarios related to when the new capacities are commissioned (some reactors in the #200GW scenario are expected to be connected to the grid faster compared to the #150GW scenario capacities evolution)

2 The future of European competitiveness

International Monetary Fund for macroeconomic forecasts, but also by national associations or private companies for strategic decisions. The input-output tables for the EU-27 have been obtained from the Eurostat database.

Input-output analytical tables (also known as symmetric input-output tables) form a basis from which a wide range of macroeconomic models and impact analyses can be constructed. The core of these tables consists of a square matrix of intermediate consumption with the same structure in columns and rows either product-by-product or industry-by-industry. We use industry-by-industry input-output tables due to our objective of identifying an impact of a specific industry in the economy. In this case, every column represents the structure of inputs to a given industry from all industries in the economy. Every row represents the usage of the output of a given industry by all industries in the economy. These relations between inputs and outputs reflect the technological connections between industries, which enables us to analyse the impact of a change in one industry (retail and wholesale trade) on the economy as a whole.

The analysis of symmetric input-output tables leads to the calculation of direct, indirect and induced effects of a given change in the economy. Direct impact is measured by changes in production volume, gross value added and employment on the companies in the specific industry level. Indirect and induced impacts are estimated through the detailed input-output model. Companies use goods and services from suppliers and the indirect impact covers companies´ effect throughout its supply chain. The employment increases as a result of the direct and indirect impact. As a consequence of higher employment, the level of household income increases throughout the economy. A proportion of this change in income will affect spending on final goods and services, which is considered to be the induced effect.

The starting point for the quantitative impact assessment is a nuclear capacity of 106 GW. To understand how nuclear energy can help Europe reach 2050 GHG emissions reduction targets, a #200GW nuclear capacity scenario will be considered. For comparison, a #100GW Scenario and a #150GW Scenario will be analysed. All three scenarios are the result of a thorough examination conducted by Compass Lexecon part of FTI Consulting LLP, commissioned by Nucleareurope[3]. The #200GW Scenario combines the long-term operation of existing nuclear power plants, new projects currently under construction or in the planning stage, as well as additional new projects.

Table 3 – Evolution of the nuclear capacities and share of electricity production in the scenarios

Applied nuclear scenarios	Capacity [GW]	Period
Current	106	2023
#100GW Scenario	100	2025 - 2050
#150GW Scenario	150	2025 - 2050
#200GW Scenario	200	2025 - 2050

Source: Deloitte analysis, Client information

3 compasslexecon.com - Pathways to 2050: the role of nuclear in a low-carbon Europe

The study is aimed at estimating the overall economic and social benefits associated with the nuclear power industry in the European Union. The objectives of the study are as follows:

- ✓ Calculate the overall **current** and **potential economic benefits** that the nuclear power industry has on **employment** and the creation of **state revenues** and **economic growth** (impact on economic output) within the European Union;
- ✓ Assess the economic effects generated **directly** by the operators of nuclear power plants and the nuclear supply chain, as well as **indirect impacts**, measured as the companies´ effect throughout its supply chain and **induced impacts,** measured as the income that will affect spending on final goods and services;
- ✓ Present the economic impact of the **current footprint of the industry** and compare the two **nuclear capacity evolution scenarios** with the **#100GW Scenario**;
- ✓ Provide a detailed insight about the **direct, indirect** and **induced impact** deriving from nuclear industry activities, analysing all of EU-27 Member States separately, whether with or without nuclear energy generation capacities;

Moreover, the study provides a general overview and certain insights into the industry context, background information and key facts on the specifics of nuclear power generation and its supply chain. The forecast period covered in this report is 2025-2050. A detailed description of the methodology for the impact assessment and the underlying assumptions of the results are presented in the Appendix of this document.

II. The European Nuclear Power Industry – State of play and future opportunities

Overview of the nuclear industry in the European Union

A part of the European Union member states, will rely on nuclear energy to generate part of their electricity for the decades to come. The countries which plan to keep or develop nuclear energy as part of their energy mix highlight the positive impact on energy security, competitiveness, and clean electricity targets.

The EU has one of the most advanced legally binding and enforceable regional framework for nuclear safety in the world and, despite diverging views among Member States on nuclear generated electricity, there is a shared recognition of the need to ensure the highest possible standards for the safe and responsible use of nuclear power and to protect citizens from radiation.

The safety standards for nuclear power plants in the Europe are formalized in the national action plans of the Europe member states and the European Commission monitors the implementation of those plans through the European Nuclear Safety Regulators Group.[4] The Nuclear Safety Directive from 2009 and its amendment from 2014 build the legal framework for nuclear safety in the EU, being considered as the world's most advanced legally binding framework in this field, as it sets an ambitious EU-wide objective of reducing the risk of accidents and avoiding large radioactive releases.[5]

Nuclear power plants in the EU

In October 2024, there were 100 nuclear power reactors in operation in 12 States, with a total estimated capacity of 106 GW. In France and Slovakia, two reactors were under construction[6], while some EU countries plan to build new plants until 2050. Germany shut down 17 reactors from 2011 until 2023.

Except Germany, all European Union member states with nuclear capacities are currently either analysing the potential long-term operation (LTO) of the existing fleet or planning to build new projects.

On the other hand, countries currently without nuclear capacities are Austria, Cyprus, Denmark, Estonia, Greece, Germany, Croatia[7], Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, Poland and Portugal. In Poland, 3 reactors are forecasted to be connected to the grid by 2036, 2037 and 2038.

4 European Commission 2017a.

5 Ibid.

6 Statista, Number of operational, shutdown, and planned nuclear reactors in European countries as of September 2024.

7 The NEK (Nuklearna Elektrarna Krško) reactor in Slovenia is owned in equal shares by the Slovenian and Croatian legal successors of the power plant founders. Thus, impact figures are higher for Croatia compared to other countries without nuclear capacities.

The current landscape of nuclear power generation reactors in the EU is presented in the table below.

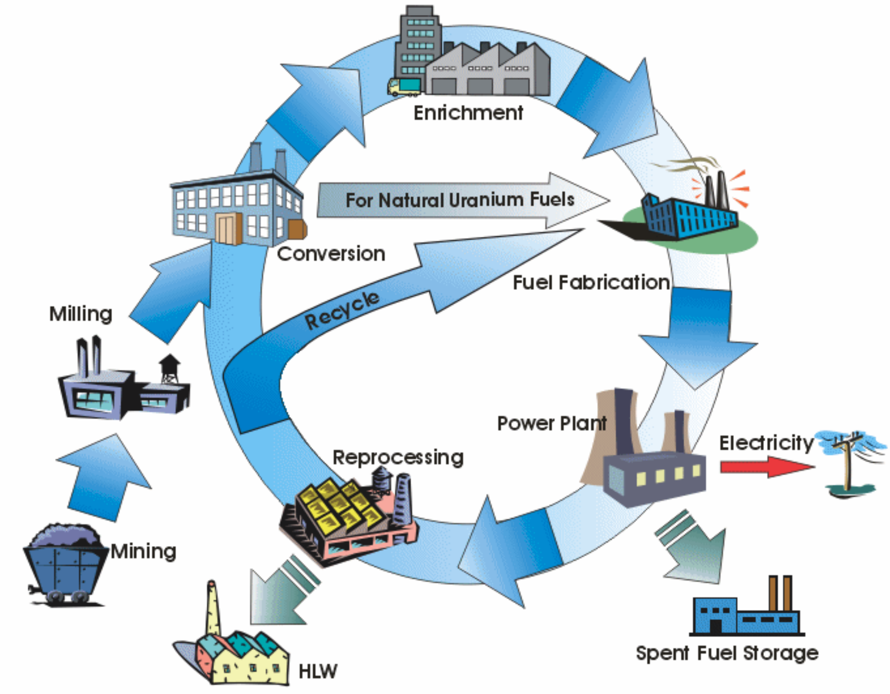
Table 4 - Landscape of nuclear reactors in the EU-27 in the #200GW scenario

#200GW scenario landscape of nuclear reactors in the EU-27	
In operation today*	100
Expected to be decommissioned until 2050	58
Planned and envisaged until 2050	356
In operation in 2050	**398**

**Note: Situation as of 2024*
Source: Client Information & Statista

Nuclear fuel cycle[8]

Figure 1- Nuclear fuel cycle



Source: M. Mohapatra and B.S. Tomar, 2013

Uranium is a slightly radioactive metal that occurs throughout the Earth's crust. It is about 500 times more abundant than gold and about as common as tin. It is, for example, found in concentrations of about four parts per million (ppm) in granite, which makes up 60% of the Earth's crust. In fertilizers, uranium concentration can be as high as 400 ppm (0.04%), and some coal deposits contain uranium at concentrations greater than 100 ppm (0.01%). There are a number of areas around the world where the concentration of

8 World Nuclear Association 2017.

uranium in the ground is sufficiently high that extraction of it for use as nuclear fuel is economically feasible. Such concentrations are called ores.

Uranium mining

Both excavation and in situ techniques are used to recover uranium ore. Excavation may be underground and open pit mining. In general, open pit mining is used where deposits are close to the surface and underground mining is used for deep deposits, typically greater than 120 m deep. Open pit mines require large holes on the surface, larger than the size of the ore deposit, since the walls of the pit must be sloped to prevent collapse. Underground mines have relatively small surface disturbance and the quantity of material that must be removed to access the ore is considerably less than in the case of an open pit mine.

Uranium milling

Milling, which is generally carried out close to a uranium mine, extracts the uranium from the ore (or ISL leachate). Most mining facilities include a mill, although where mines are close together, one mill may process the ore from several mines. Milling produces a uranium oxide concentrate which is shipped from the mill. It is sometimes referred to as 'yellowcake' and generally contains more than 80% uranium. The original ore may contain as little as 0.1% uranium, or even less. U3O8 is the uranium product which is sold. About 200 tones is required to keep a large (1000 MWe) nuclear power reactor generating electricity. Such milling operations is quite complex[9], involving crushing, screening, agglomeration, stacking and heap leaching, uranium recovery and purification by solvent extraction, ammonium diuranate precipitation and calcination. Depending on the amount of recoverable ore, such mills can operate for 2 or more decades, generates hundreds of direct jobs and additional five folds indirect jobs during this period. That is why is often welcomed by local communities and authorities[10]

Uranium and plutonium recycling

The uranium recovered from reprocessing, which typically contains a slightly higher concentration of U-235 than occurs in nature, can be reused as fuel after conversion and enrichment. The plutonium can be directly made into mixed oxide (MOX) fuel, in which uranium and plutonium oxides are combined. In reactors that use MOX fuel, plutonium substitutes for the U-235 in normal uranium oxide fuel. Increasingly, today's used fuel is being seen as a future resource rather than a waste.

Wastes

Wastes from the nuclear fuel cycle are categorized as high-, medium- or low-level wastes by the amount of radiation that they emit. These wastes come from a number of sources and include:

a) low-level waste produced at all stages of the fuel cycle;
b) intermediate-level waste produced during reactor operation and by reprocessing;

9 https://www.mining-technology.com/projects/salamanca-uranium-project/

10 https://www.berkeleyenergia.com/more-than-a-thousand-from-local-community-sign-petition-in-support-of-the-salamanca-project/

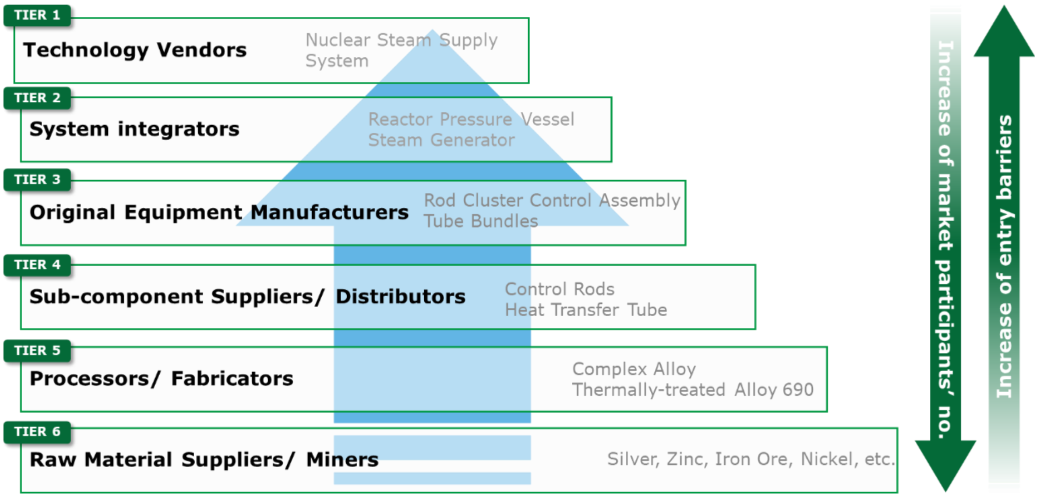
c) high-level waste, which is waste containing the highly-radioactive fission products separated in reprocessing, and in many countries, the used fuel itself. Separated high-level wastes also contain long-lived transuranic elements.

After reprocessing, the liquid high-level waste can be calcined (heated strongly) to produce a dry powder which is incorporated into borosilicate (Pyrex) glass to immobilize it. The glass is then poured into stainless steel canisters, each holding 400 kg of glass. A year's waste from a 1,000 MWe reactor is contained in five tonnes of such glass, or about 12 canisters 1.3 metres high and 0.4 metres in diameter. These can readily be transported and stored, with appropriate shielding.

Nuclear supply chain[11]

The sourcing of nuclear energy consists of one of the most complex supply chains in the world. It typically consists of 6 tiers, each being under strict government guidelines and regulations from international and national sources. Starting from the beginning of the value chain, these are raw material suppliers, fabricators, sub-component suppliers, original equipment manufacturers, system integrators and technology vendors.

Figure 2 - Nuclear Supply Chain



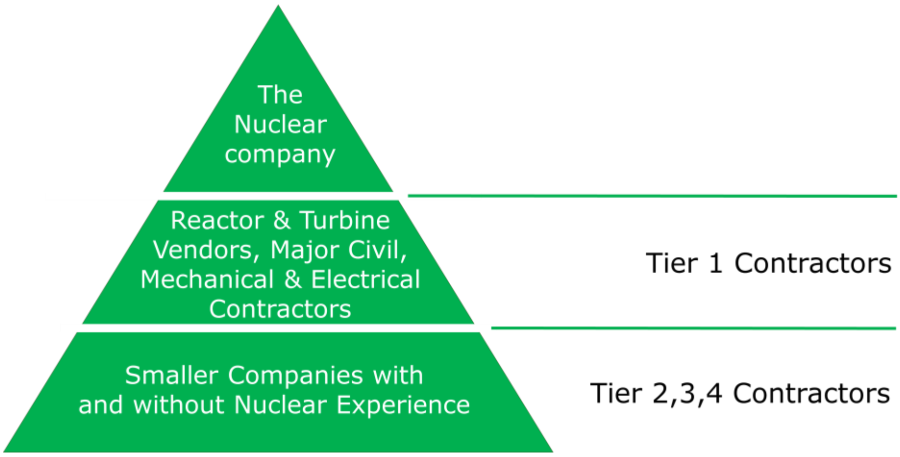
Source: World Nuclear Association 2014

Particularities of the nuclear supply chain often refer to an increased degree of quality standards. Throughout the whole supply chain, exceptional quality standards are required from 'nuclear-grade' safety-related components, which are higher than normal 'industrial or commercial grade'. Moreover, sector-specific performance and safety testing are required for the goods offered by suppliers, which raises two challenges concerning preparedness and capability to deliver at such high standards. Secondly, suppliers are confronted with the profitability challenge, which is a natural consequence of increased quality standards and derives from the first two challenges.

11 Sitler, Andrea L. 2010.

Vendors

Figure 3 - A typical procurement pyramid



Source: Nuclear Industry Association 2013

The market opportunities associated with the development of reactors at can be split into:

- Civil Works
- Nuclear Steam Supply System
- Mechanical Systems – nuclear and non-nuclear
- Electrical Systems – nuclear and non-nuclear
- Turbine

Recycling Technologies

Recycling allows 30% more energy to be extracted from the original uranium and leads to a great reduction for wastes to be disposed of. Overall, the closed fuel cycle cost is assessed as comparable with that for direct disposal of spent fuel and preserves a resource that may become more valuable in the future.

Decommissioning of Plants and Transportation of Radioactive Waste

During their life cycle, plants are required to set up a fund that will cover the costs of decommissioning. The decommission process can take 20 or more years.

Plant decommissioning is a multi-step process. This entails the removal and disposal of radioactive components and materials such as the reactor and associated piping and the clean-up of radioactive or hazardous contamination that may remain in the buildings and on the site. Radioactive materials must be handled in a fashion to reduce risk. The entire facility is sealed off to allow the grounds to return to a radiation safe zone. The energy generation room is sealed for a pre-determined time after the rods are removed. Hot rods from working plants are not immediately shipped upon decommission. Instead, there is a long-term process taken to further reduce the risk of contamination during transit.

Transport of Nuclear Waste

Risk reduction methods entail spent fuel rods being placed in water pools to cool for at least 5 years before being transported to their first intermediate storage facility where they will remain for another 30 to 100 years. During this stay, radiation levels will reduce significantly. Spent fuel rods are transported via rail and truck. They must be transported in cement casks manufactured specifically for this purpose.

Please consult Figure 3 for an overview over the components that are offered by every tier of the supply chain.

Nuclear reactor technologies and generations

As a well-established large-scale low-carbon technology in power generation, nuclear energy has the potential to play a decisive role in realizing the EU's ambitious GHG emissions reduction targets for 2050.

The importance of LTO is expected to increase in the coming years, as by 2030, the majority of nuclear reactors would be operating beyond their original design life. Long-term operations are likely to represent the majority of nuclear investments in the short to medium term. The main recitals for LTO are linked to electricity market conditions, but have to take in consideration social and political factors, as well. Today, the operational lifetime extension of a nuclear power reactor has already been approved in several European countries including Romania[12], Finland[13], France[14], Slovenia[15], Hungary[16]. Such decisions are subject to a strict and comprehensive safety review by the competent independent national regulator, and highest safety standards have to be implemented.

In Table 5, installed capacity figures for existing, LTO and new nuclear reactors are shown for the short, medium and long term.

Table 5 - Installed nuclear capacity for the period 2025 - 2050, #200 Scenario

Installed nuclear capacity for #200 Scenario [MW]				
	2025	2035	2045	2050
Existing	1,917	1,917	-	-
LTO	96,570	96,570	91,797	44,686
New	4,942	59,082	133,682	156,182
Total	103,429	157,569	225,479	200,868

Source: Deloitte analysis, Client information

12 https://www.nuclearelectrica.ro/project-development-activities/refurbishment-of-cernavoda-npp-unit-2/?lang=en

13 https://www.nucnet.org/news/fortum-to-modernise-low-pressure-turbines-at-loviisa-nuclear-station-5-4-2024

14 https://www.nucnet.org/news/edf-secures-eur5-8-billion-in-green-loans-for-nuclear-life-extensions-5-2-2024

15 https://www.nucnet.org/news/lifespan-of-slovenia-s-krsko-to-be-extended-until-2043

16 World Nuclear Association 2024

Main nuclear reactor technologies[17]

Currently the most used nuclear reactor design worldwide is the **pressurized water reactor (PWR)**, with notable exceptions being Japan and Canada. It has water at over 300°C under pressure in its primary cooling/ heat transfer circuit and generates steam in a secondary circuit. PWRs are one of three types of **light water reactor (LWR)**, the other types being **boiling water reactors (BWRs)** and **supercritical water reactors (SCWRs)**. Russia's VVER reactors are similar to U.S. PWRs (please see the footnote)[18]. France operates many PWRs to generate the bulk of its electricity.

The **boiling water reactor (BWR)** produces steam in only one circuit above the reactor core, but at slightly lower temperatures and pressure compared to the PWR. Both types use water as both coolant and moderator, to slow neutrons. Since water normally boils at 100°C, they have robust steel pressure vessels or tubes to enable the higher operating temperature.

The **pressurized heavy water reactor (PHWR)** design has been developed since the 1950s in Canada and is widely known as the **CANDU**. PHWRs generally use natural uranium oxide as fuel, hence it needs a more efficient moderator, in this case heavy water (D_2O). The PHWR produces more energy per kilogram of mined uranium than other designs, but also produces a much larger amount of used fuel per unit output. CANDU reactors can accept a variety of fuels.[19]

Finally, new non water-cooled technologies, commonly called Generation 4 reactors, are set to debut in the near future. High-temperature systems offer the possibility of efficient process heat applications and eventually hydrogen production. Enhanced sustainability is achieved primarily through the adoption of a closed fuel cycle including the reprocessing and recycling of plutonium, uranium and minor actinides in fast reactors and also through high thermal efficiency. This approach provides a significant reduction in waste generation and uranium resource requirements. Depending on their respective degrees of technical maturity, the Generation IV systems are expected to become available for commercial introduction between now and 2050. These include the: Gas-cooled Fast Reactor (GFR), Lead-cooled Fast Reactor (LFR), Molten Salt Reactor (MSR), Supercritical Water-cooled Reactor (SCWR), Sodium-cooled Fast Reactor (SFR) and Very High Temperature Reactor (VHTR).

For a comprehensive list of existing nuclear units throughout EU-27, please consult the set of assumptions in the Appendix.

Main nuclear reactor generations

Currently, the majority of reactors are considered 2nd Generation, as the vast majority of the 1st Generation were retired some time ago. There are only a few 3rd Generation

17 World Nuclear Association 2018.

18 The water-water energetic reactor (WWER) represents a series of pressurized water reactor designs originally developed in the Soviet Union, and now Russia. VVER were originally developed before the 1970s, and have been continually updated. Power output ranges from 70 to 1200 MWe, with designs of up to 1700 MWe in development.

19 A table with all the Operating and New European power plants can be found in the Appendix, in the Set of assumptions

reactors that have reached the commercial stage as of 2022. Thus, there is no clear distinction between the 2nd and the 3rd Generation.

Small modular reactors (SMRs) have several design features that differentiate them from other sources of power generation. In contrast to large nuclear that typically have electricity output in excess of 700 MW(e), SMRs are relatively small, producing around 300 MW(e). While globally there exist a number of designs and operating reactors that fall into the size range of SMRs, they lack the other characteristics associated with SMR design.[20]

Micro Nuclear Reactors (MNRs) are a distinct class of small reactor systems, typically of under 10MWe electrical thermal output, which could occupy distinct and different market niches, in comparison to larger Small Modular Reactors (SMR's).[21]

Concerning the 4th Generation, an international cooperation framework is sharing R&D to develop six nuclear reactor technologies. Four of them are fast neutron reactors. All of these operate at higher temperatures than today's reactors. In particular, four are designated for hydrogen production.[22]

All six systems represent advances in sustainability, economics, safety, reliability and proliferation-resistance. **Europe is pushing ahead with two of the fast reactor designs:**

1. As a first alternative technology, the lead-cooled fast reactor (ALFRED) with the construction of an experimental reactor to demonstrate the technology, in another European country willing to host this program, and supported by a lead-bismuth irradiation facility project in Belgium (MYRRHA);
2. As a second alternative technology, the gas-cooled fast reactor (ALLEGRO), also requiring the construction of technology demonstrator in a European country.[23]

Nuclear research in Europe[24]

The nuclear research in Europe encompasses multiple layers of local and centralized initiatives and programs. While various companies and organisations trigger and support local or regional R&D plans, the centralized plans are usually funded through EU multiannual framework programmes. Case in point, the Euratom Research and Training Programme complements, but remains separate from Horizon Europe (the EU framework programme for research and innovation) and from ITER (the International Thermonuclear Experimental Reactor).

The **Euratom Research and Training Programme** (2021-2025) pursues the following key research activities through direct and indirect actions:[25]

- ✓ nuclear safety
- ✓ security

20 https://www.iaea.org/newscenter/news/what-are-small-modular-reactors-smrs

21 Nuvia 2016.

22 World Nuclear Association 2018.

23 https://snetp.eu/wp-content/uploads/2023/09/ESNII_Vision_Paper_2022.pdf

24 European Parliament 2019a.

25 Euratom Research and Training Programme - European Commission

- ✓ radioactive waste
- ✓ spent fuel management
- ✓ radiation protection
- ✓ fusion energy

The European Commission has launched several projects under the Euratom Research and Training Programme over the last decades. These research and innovation actions contribute to improving nuclear safety, management of radioactive waste, radiation protection, and safe use of nuclear power and of non-power applications of ionising radiation. Some recent projects include[26]:

- The NPHyCo project supports EU's decarbonisation goals by 2050. It explores the technical, operational and economic feasibility and viability for existing Nuclear Power Plants (NPPs) to generate large amounts of hydrogen, which will play a key role in our future energy systems, and for delivering on the aim set out in the European Green Deal.

- The TANDEM project develops assessments and tools to facilitate the safe, secure and efficient integration of SMRs into smart low-carbon hybrid energy systems. It focuses on two main case studies: a district heating network and power supply in an urban area, and an energy hub serving energy conversion systems, including hydrogen production, in a regional perspective.

ITER, previously known as the International Thermonuclear Experimental Reactor, is an international nuclear fusion research and engineering megaproject with the objective of generating energy through a fusion process similar to that of the Sun. ITER is located near the Cadarache facility in southern France. It will be the largest fusion reactor ever built, with a plasma volume six times greater than that of the JT-60SA in Japan, the largest operating tokamak today. The objectives of ITER include achieving sufficient fusion to produce ten times the thermal output power compared to the thermal power absorbed by the plasma for short periods, testing technologies needed for operating a fusion power plant, achieving and learning from a burning plasma, testing tritium breeding, and demonstrating the safety of a fusion plant. Despite the initial expectation that the reactor would be constructed within a decade, with the first plasma tests scheduled for 2020 and full fusion by 2023, a revised timeline published in 2024 now anticipates the initiation of deuterium-deuterium plasma operations in 2035.

[26] Euratom research and training programme 2021-2025 - Publications Office of the EU

III. Current contribution of the Nuclear Power Industry to the EU-27 economy

The impact assessment takes into consideration the current nuclear energy production throughout the entire EU-27 and is quantified in billion Euro. Individual assessments for each country are to be found in the Appendix.

The primary object of this study consists of analysing the following indicators: **employment, state revenues, EU economic output and disposable household income,** which can be measures of the direct, indirect and induced impact that the nuclear energy industry has on the EU-27 economy. For more details related to what direct and indirect impact imply, please consult the methodological notes section presented in the Appendix.

The results show that the nuclear industry has a significant impact on affiliated industries and the EU-27 economy as a whole. The present chapter provides a detailed view on the current impact, while the future impact with a horizon of 25 years is presented in Chapter IV.

The overall figures for current impact are presented in the following figure.

> The **nuclear sector** has a significant impact on the **European economy**, supporting **over 883 thousand jobs in 2023** and an **impact in the EU-27 economic output of 251.2 bn. EUR**

Figure 4 - Overview of the current impact of the nuclear industry

2023 IMPACT

251.2 bn. EUR	in **EU economic output** generated by nuclear sector
883,700	average **number of jobs sustained** by the nuclear sector
38.0 bn. EUR	disposable **household income** due to the activities of the EU nuclear industry
47.6 bn. EUR	**public revenues** generated through tax payments due to the nuclear sector

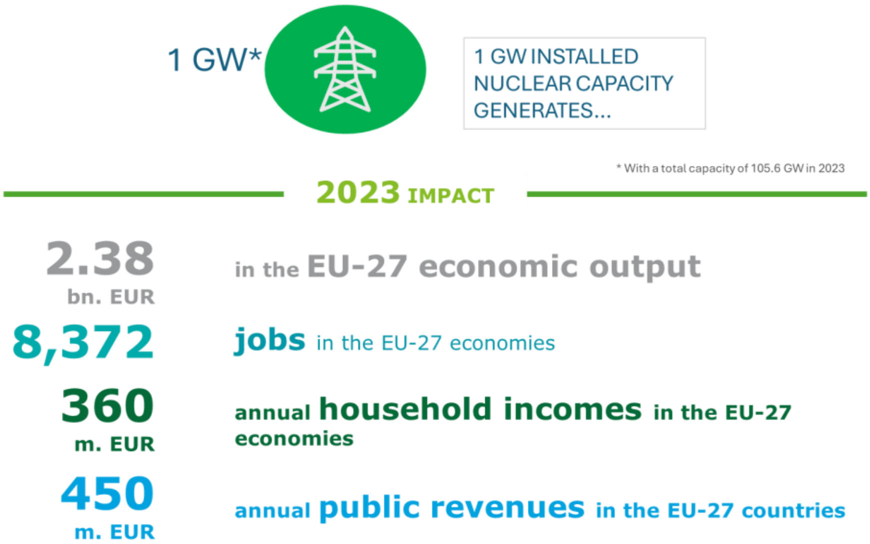
Source: Deloitte calculations

The results of the current impact assessment show that in 2023, the nuclear industry sustained **883,700 full-time jobs**, generated **47.6 bn. Euro in state revenues**, **38.0 billion Euro in household income** and **251.2 billion Euro in the EU-27 economic output**.

Another approach to exemplify the economic benefits arising from the activities of the EU nuclear industry is to show the impact of **1 GW** installed nuclear capacity on the economy. According to that, every GW of installed nuclear capacity in the European Union generated a 2.38 billion Euro impact on the EU economic output, a 360 million Euro impact on household incomes and a 450 million impact on public revenues. What is more, every GW installed of nuclear capacity sustained more than 8,000 direct, indirect and induced jobs in 2023.

Every GW installed of nuclear capacity **generated 2.38 billion Euro** in the EU economic output in 2023

Figure 5 - Impact of 1 GW installed nuclear capacity on the EU-27 economies, 2023



Source: Deloitte calculation

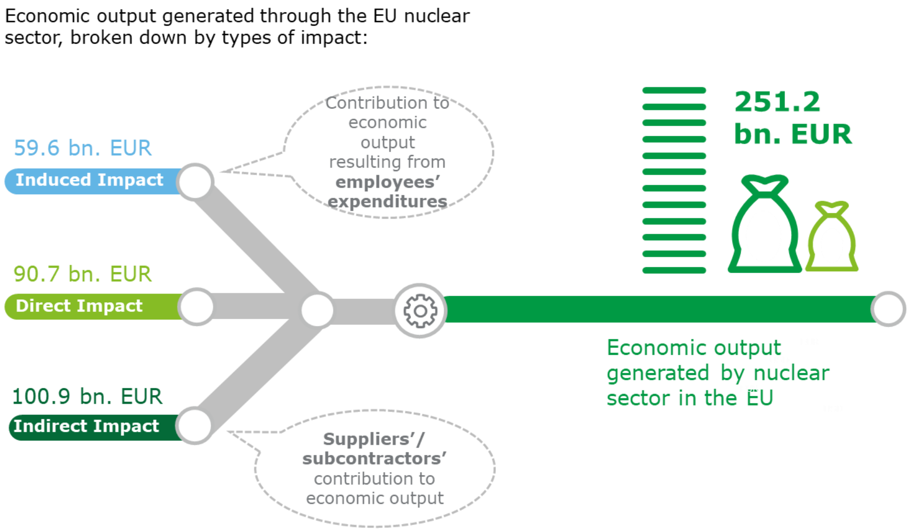
Impact on the EU-27 economic output

The **direct impact** is comprised of the activities directly associated to nuclear power generation, construction of nuclear reactors and decommissioning and amounts to **90.7 billion Euro**. The **indirect impact** reaches **100.9 billion Euro** and is generated through suppliers and subcontractors' contribution in the nuclear supply chain in the EU economies. The **induced impact** amounts **59.6 billion EUR** and is generated by the employees' expenditures. Finally, the overall impact of the nuclear sector on the European economic output totals **251.2 billion Euro** in 2023.

The current impact in the **EU-27 economic output** amounts to **251.2 billion EUR**

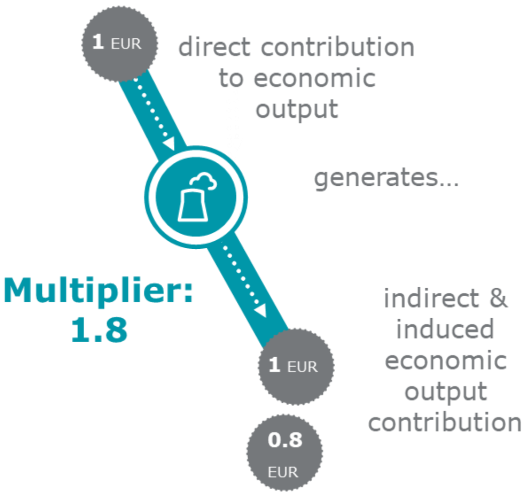
The figure presented below captures the effects of the nuclear industry on the current EU economic output.

Figure 6 - Impact on EU-27 economic output, 2023



Source: Deloitte calculations

Figure 7 – EU-27 Economic Output Multiplier, 2023



Source: Deloitte calculations

The multiplier effect is an intuitive indicator to assess the overall effects deriving from the nuclear industry. As shown in the figure on the left, **every Euro** of direct impact in the EU-27 economic output created by the nuclear industry generates an indirect and induced impact of **1.8 Euro** and an overall impact of **2.8 Euro** in the economic output of the EU-27.

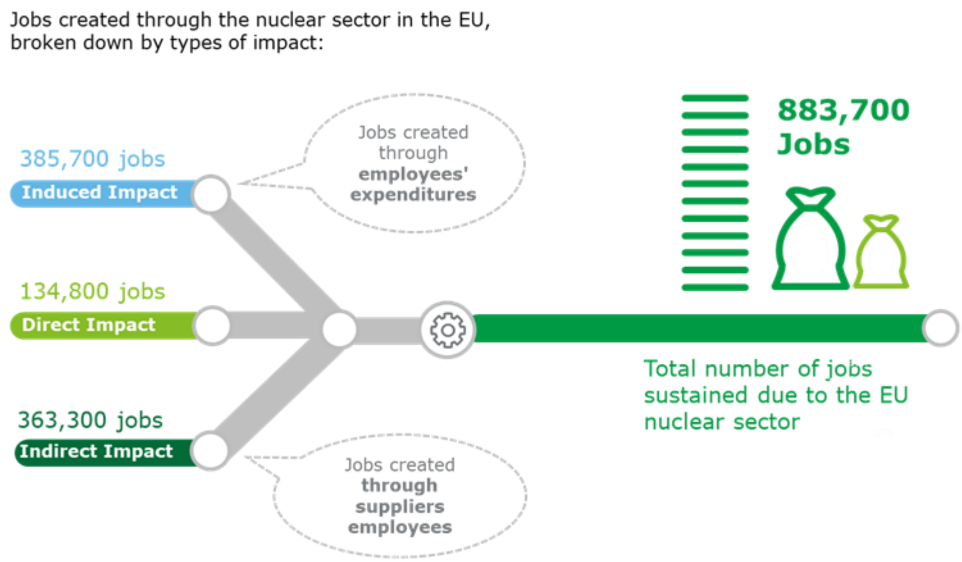
Today, **every Euro** of direct impact of the nuclear industry will generate a total of **2.8 Euro** in the EU-27 economic output

Impact on employment

The assessment for the impact of today's nuclear industry on the labour force markets shows that every year, **134,800 jobs** are **sustained directly** through the industry's performance. These direct jobs **indirectly sustain** other **363,300 jobs** offered and sustained on average by the suppliers every year. What is more, the indirect impact includes jobs created through the expenditures of the suppliers' employees in other economic sectors, whereas the induced impact sustains **385,700 jobs** created through employees' expenses. Overall, the nuclear industry accounts for more than **883,700 million jobs**, signifying that, through the nuclear industry's economic activities, **883,700 jobs are currently sustained in the EU labour force market.** Please consult the figure below for an overview of current impact on employment.

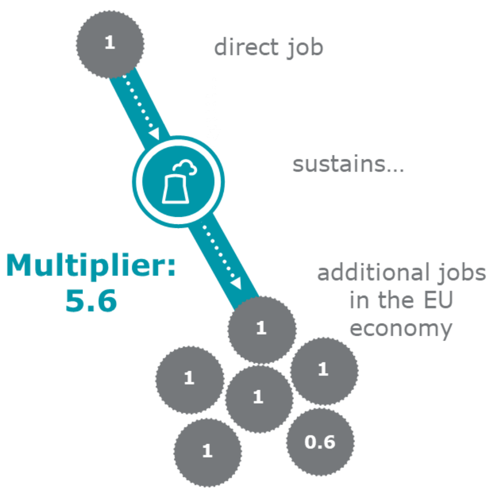
In 2023, the nuclear industry sustained **more than 883 thousand jobs** throughout the EU labour force market

Figure 8 - Impact on employment, 2023



Source: Deloitte calculations

Figure 9 - Jobs multiplier, 2023



Every direct job in the nuclear industry generates **5.6 indirect jobs throughout the EU-27 labour force market** in the present. Altogether, 1 job in the nuclear industry sustains a total of **6.6 jobs** in the EU-27.

Source: Deloitte calculations

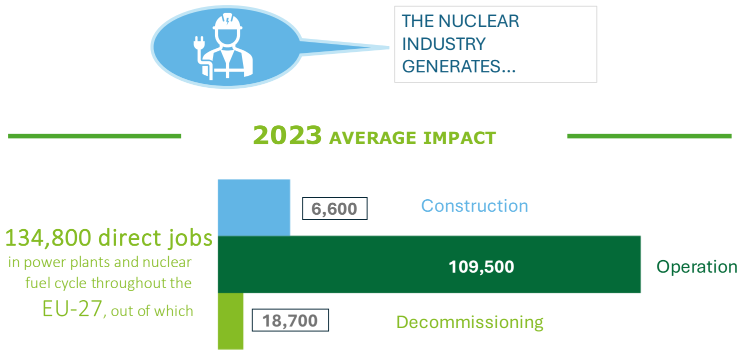
Employment during the nuclear lifetime phases

Compared to other sectors, the nuclear industry is considered a labour-intensive energy generation technology.[27] The nuclear life cycle can be separated into three major phases: construction, operation and decommissioning. The construction phase takes approximately 10 years, whereas the operation phase is considered to last over 60 years - the design lifetime of generation III reactors. Decommissioning is expected to be completed after 20 years.[28] During the three phases, both labour intensity and types of supplied labour differ significantly.[29] Main activities during the construction phase are to be divided in field craft labour and field non-manual labour. Field craft labour is the largest component of the construction workforce, 70% to 75% of the field work force are employed to realize the conventional nuclear plant construction. The field craft labour category comprises civil, electrical, mechanical, piping and instrumentation personnel used during the installation and start-up of the units. On the other hand, the field non-manual labour is the smaller part of the construction workforce and accounts for approximately 25% to 30%. The non-manual labour force comprises of field management, field supervision, field engineers, quality assurance/quality control, environmental-safety and health and administrative/clerical staff.[30]

During the operation phase, job activities are mainly in the following categories: engineering, materials and services, operations, maintenance, support services, training and management.[31]

Decommissioning phase implies project management and engineering activities that range from site restoration, (environmental) remediation services and waste management services.[32]

The figure below shows the different impact figures for 2023 on employment throughout the three lifetime phases of the nuclear power industry. In 2023, 109,500 jobs have been sustained in the operation phase in the European Union. Moreover, in 2023 6,600 jobs have been directly sustained through construction works in nuclear power plants.



Source: Deloitte analysis

27 Please consult the last subchapter of chapter IV for a comparison with wind and hydro sectors.

28 OECD 2018.

29 Ibid.

30 Ibid.

31 Ibid.

32 Ibid.

Impact on disposable household income

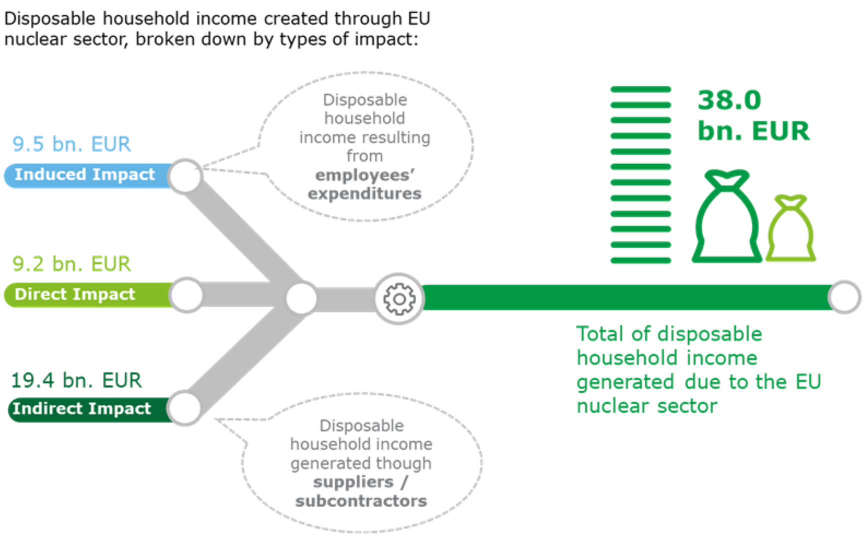
Disposable household income is the amount of money that households have available for spending and saving after income taxes have been accounted for. Disposable income is often monitored as one of the key economic indicators and used to gauge the overall state of the economy.

Today, the nuclear industry generates an annual disposable household income of **38.0 billion Euro**. The direct impact represents the disposable household income of employees directly working in nuclear power plants and involved in the construction/decommissioning of nuclear reactors and amounts to **9.2 billion Euro** throughout the period. The indirect impact totalizes **19.4 billion Euro** of disposable household income generated though suppliers and subcontractors. The disposable household income resulting from employees' expenditures amounts to **9.5 billion Euro.**

In 2023, the nuclear industry accounted for a **total of 38.0 billion Euro of disposable household income** in the EU-27

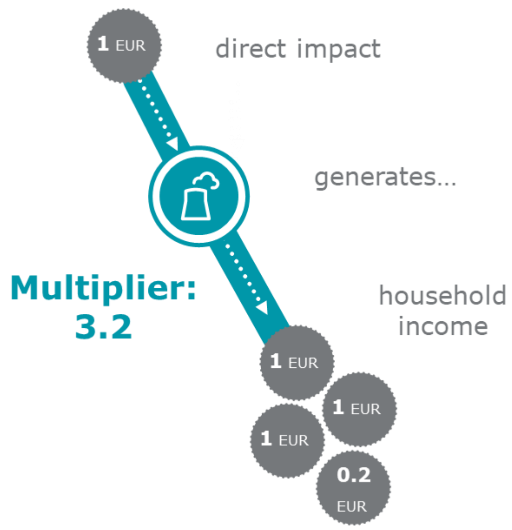
The figure presented below captures the impact of the industry on disposable household incomes throughout the EU-27.

Figure 10 - Impact on disposable household income, 2023



Source: Deloitte calculations

Figure 11 - Disposable household multiplier, 2023



Every Euro generated as direct impact of the EU-27 nuclear sector generates a household income of **3.2 Euro** and a total of **4.2 Euro** in disposable income among European households today.

With every Euro generated in household incomes, the nuclear industry generates a total of **4.2 Euro of household income** in the EU-27

Source: Deloitte calculations

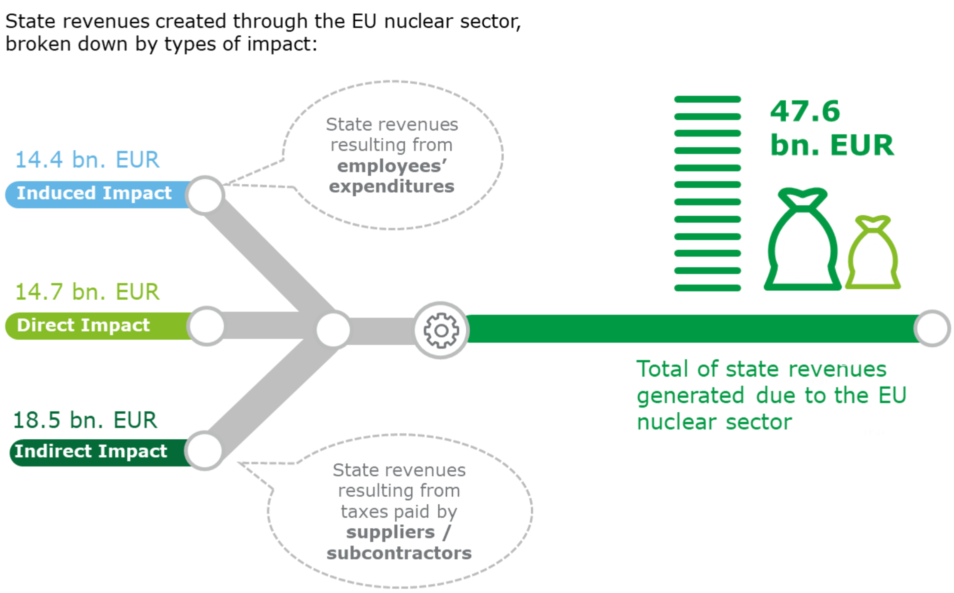
Impact on public revenues

Taxes deriving from the EU-27 nuclear sector activity significantly contribute to the national budgets of Europe. For the current period, total impact on public revenues generated through the nuclear industry amount to **47.6 billion Euro**.

The current **direct impact** that the nuclear industry has on state revenues through tax contributions amounts to **14.7 billion Euro,** whereas the **indirect and induced impact** amounts to **18.5 billion Euro**, respectively **14.4 billion**. Additionally, the effects on the economy through the expenditures of the operators' and suppliers' employees are included in the induced and indirect impact.

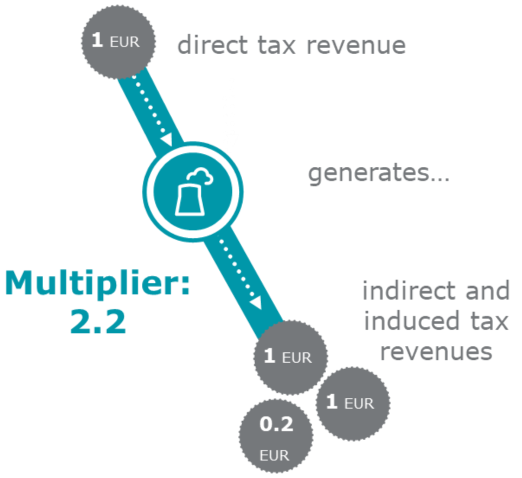
The nuclear industry currently generates a **total of 47.6 billion Euro in public revenues** per year in the EU-27

Figure 12 - Impact on EU-27 public revenues, 2023



Source: Deloitte calculations

Figure 13 - Public revenues multiplier,2023



Source: Deloitte calculations

Every Euro paid directly by the nuclear industry through tax payments generates indirect tax revenues of **2.2 Euro** and a total of **3.2 Euro** public revenues throughout the EU-27.

Every Euro paid for taxes from the nuclear industry generates state revenues of **3.2 Euro** in the EU-27

Current nuclear industry impact on the 27 EU-countries' economies

Countries with nuclear power generation

Currently, there are 12 EU countries[33], with nuclear power generation. These countries are Belgium, Bulgaria, the Czech Republic, Spain, Finland, France, Hungary, the Netherlands, Romania, Sweden, Slovenia and the Slovak Republic. The impact of nuclear power generation in these countries derives from both direct contributions of the sector, such as contribution to the economic output, job creation and paid taxes; indirect effects, deriving from the suppliers and induced effects deriving from employees' expenditures contributions that sustain the domestic economies. Details on the impact of the nuclear industry on the national economies of EU-27 with nuclear capacities are published in the Appendix.

Today, there are **12 countries with nuclear capacities**

Member states without nuclear power generation

Concerning the 15 EU countries without current nuclear power generation (Austria, Cyprus, Denmark, Estonia, Greece, Croatia, Germany, Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, Poland and Portugal), there is a recordable impact – direct, indirect and induced, deriving from nuclear power generation, as well. Thus, the industry still has positive economic effects on these countries. This is due to the interconnectedness of the national economies and labour force markets. More precisely, countries without nuclear capacities still have qualified workforce and subcontractors providing expertise and technologies for the nuclear industries in neighbouring member states, which generates direct, indirect and induced effects in the domestic economy and labour force markets of the non-nuclear countries. Please consult the Appendix for detailed impact figures of the nuclear industry on European countries without nuclear power generation.

Even though a country has no installed nuclear capacity, positive effects still exist due to cross-border economic activities

33 European Parliament, Nuclear energy in the European Union, 2023

IV. The Contribution of the Nuclear Power Industry to the European 2050 Vision

For a thorough understanding of the future benefits the nuclear industry could have on the future EU-27 economies, the present study applied three scenarios for nuclear installed in EU-27 for the period 2025-2050.[34] As previously mentioned, these scenarios are:

- #100GW Scenario with **100 GW** installed nuclear capacity by 2050, scenario in which most existing plants close without further lifetime extension and new plants projects fail to conclude.
- #150GW Scenario with an installed nuclear capacity of **150 GW** by 2050, reflecting more ambitious policies and targets for developing nuclear capacity in the Europe.
- #200GW Scenario with **200 GW** installed nuclear capacity by 2050, scenario in which several long-term operation (LTO) extensions are awarded and a number of additional new plants are commissioned replacing thermal baseload and contributing to decarbonisation of the power sector and wider European economy. This scenario will reflect a change in paradigm, giving nuclear a central place in the transition to Net-Zero.

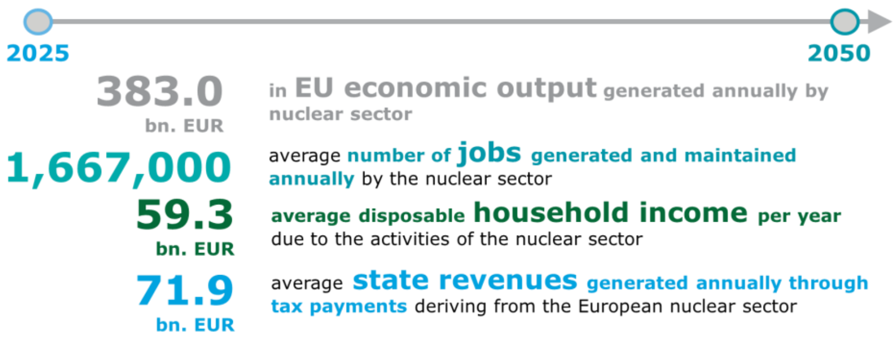
The following pages introduce and detail the future benefits of the #200GW nuclear scenario. For more information about the #150GW scenario, please consult subchapter "Economic effects in the #150GW scenario". Moreover, a comparative analysis is provided in the subchapter "Contribution to a sustainable economic growth in the EU – Impact comparison for two future scenarios". For more details on disaggregated impact results, please consult the Appendix. There you will find detailed information on future economic benefits generated by the nuclear industry in the 27 member states of the Union.

Economic benefits in the #200GW scenario

The figure shown below depicts the overall outcomes of the impact assessment for the #200GW Scenario. Its deployment would **sustain positive effects throughout all analysed areas**: economic output, employment, public revenues and household incomes. Detailed figures for each of the selected indicators are to be found on the following pages of this chapter.

34 compasslexecon.com - Pathways to 2050: the role of nuclear in a low-carbon Europe

Figure 14 - Overview of the additional economic effects in the #200 Scenario, 2025 – 2050



Source: Deloitte calculations

The results of the impact assessment for the #200GW Scenario show that the nuclear industry will **sustain annually 1,667,000 full-time jobs** throughout the period and will **generate 71.9 bn. Euro of additional cumulated state revenues, 59.3 bn. Euro in household income and 383.0 bn. Euro of additional economic output** over the analysed period (2025-2050).

The cumulated impact of the nuclear industry on **the EU-27 economic output** would amount to nearly **10 trillion Euro** until 2050

Impact on EU-27 economic output

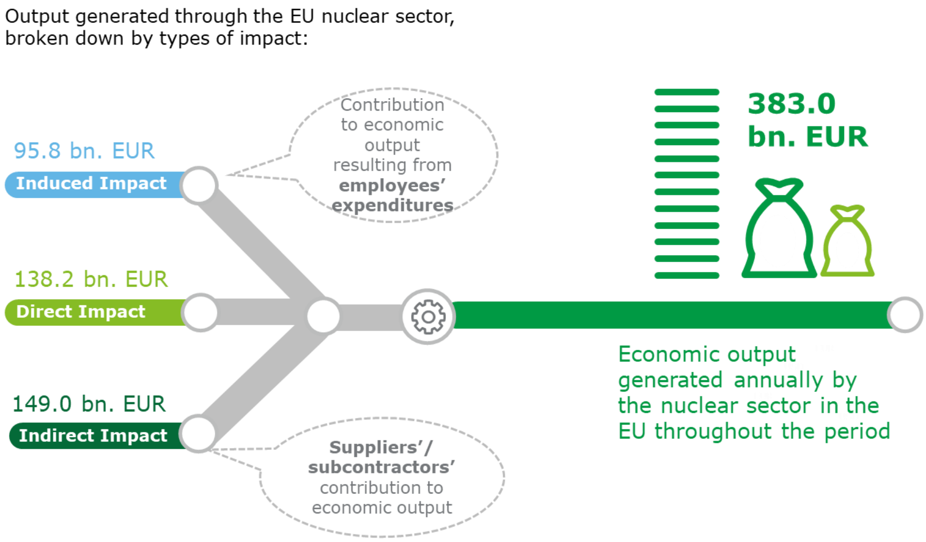
EU-27 Economic Output: In a broader sense, encompasses all the economic activities and value addition within the EU-27 economies.

The **direct impact** can be calculated through the activities associated directly to the nuclear power generation and construction/decommissioning and will reach **138.2 billion Euro**, whereas the **indirect impact** will amount to **149.0 billion Euro**, generated through suppliers and subcontractors that are engaged by the nuclear industry and the induced impact will amount to **95.8 billion Euro** resulting from employees' expenditures. Finally, the cumulated impact of the nuclear sector on the European economic output will amount to **383.0 billion Euro per year**, by 2050.

The figure presented below captures the effects on the EU-27 economic output, occurring due to the nuclear industry activities, for the period 2025 - 2050.

In the future, the nuclear industry could sustain almost 1.7 **million jobs,** generating a total of **383.0 billion Euro in EU-27 economic output** annually and **59.3 billion Euro** in annual **household income** throughout the EU-27

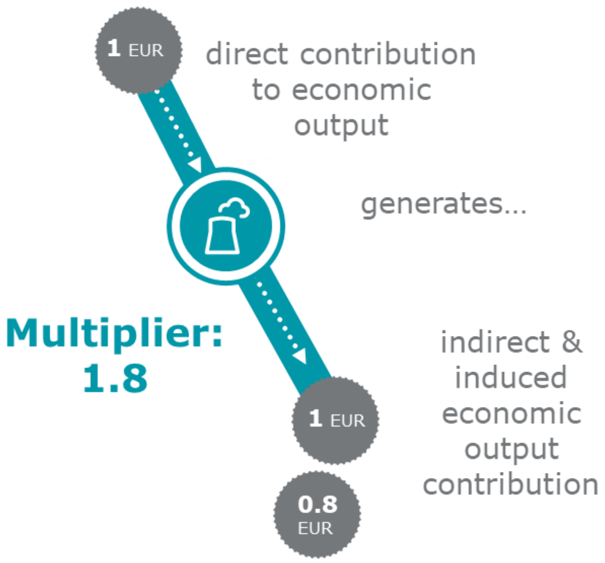
Figure 15 - Impact of the nuclear industry on the EU-27 economic output, 2025– 2050



The overall **yearly** impact of the nuclear industry on **EU-27 economic output** will amount to **383.0 billion Euro**

Source: Deloitte calculations

Figure 16 - Multiplier EU-27 economic output, 2025 – 2050



As presented in the figure on the left, the multiplier for **1 Euro** of direct impact on EU economic output due to the nuclear sector is 1.8, translating into the generation of **1.8 Euro** indirect and induced economic output contribution and **2.8 Euro** total impact on the EU-27 economic output.

Every Euro of direct impact of the nuclear industry will generate a total of **2.8 Euro in EU-27 economic output**

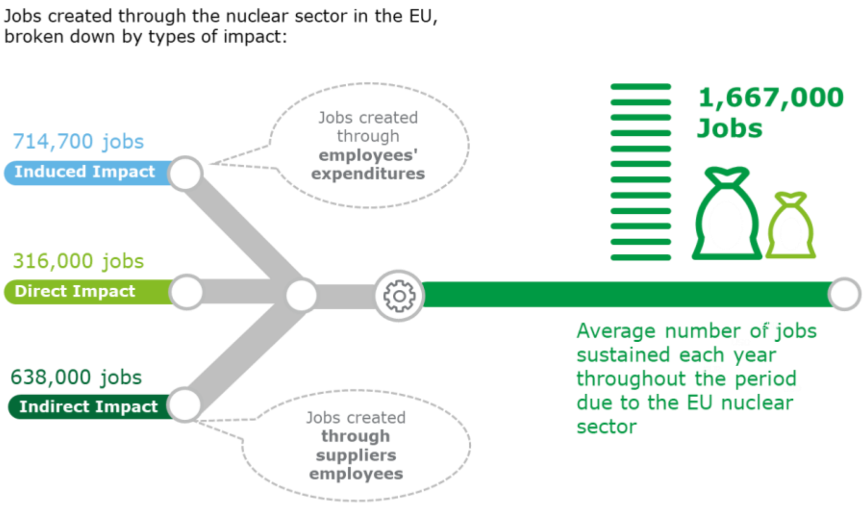
Source: Deloitte calculations

Impact on employment

The estimates indicate that between 2025 and 2050, **316,000 jobs** will be **sustained directly** through the nuclear industry every year. These direct jobs will **indirectly sustain** other **638,000 jobs** offered by the suppliers. Moreover, the indirect impact figure includes job created through the expenditures of the suppliers' employees, whereas the **induced impact** will amount to **714,700 jobs** created through the industries' employees in diverse economic sectors. Overall, the nuclear industry will account annually for approximately two million jobs, or more precisely, **1,667,000 jobs** on the EU labour force market, by 2050.

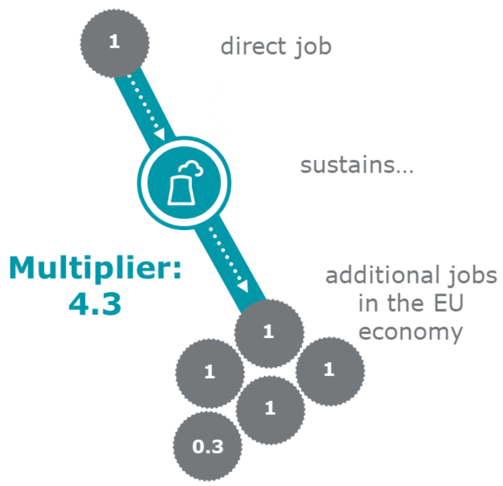
In the period 2025 - 2050, the nuclear industry could account for **approximately 1.7 million jobs annually** on the EU-27 labour force market

Figure 17 - Impact of the nuclear industry on the EU-27 labour market, 2025 - 2050



Source: Deloitte calculations

Figure 18 - Jobs Multiplier, 2025 - 2050



Source: Deloitte calculations

Every job directly generated in the nuclear industry would sustain **4.3 indirect jobs**, totalling **5.3 jobs** on the EU-27 labour force market.

In the future, every **job generated directly** in the nuclear industry will **sustain 5.3 jobs** in the EU-27

Impact on disposable household incomes in the EU-27

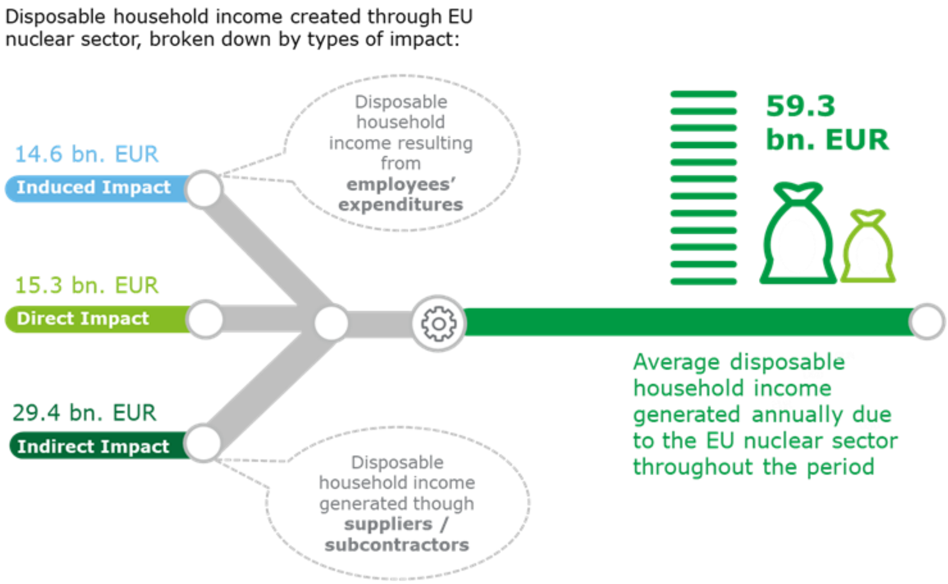
For the future period, the nuclear industry would generate on average an annual disposable household income of **59.3 billion Euro** in the period 2025-2050.

The **direct impact** created by the nuclear industry will amount to **15.3 billion Euro annually** throughout the period. The **induced impact** translates into the incomes resulting from employees' expenditures totalizing **14.6 billion Euro,** and the **indirect impact** translates into the incomes of suppliers' employees and will amount **29.4 billion** Euro.

The figure presented below shows the impact of the industry on disposable household incomes throughout the EU-27.

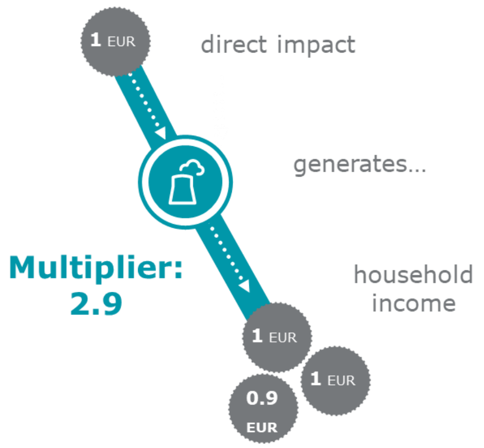
In the future, disposable household income in the EU-27 will amount to **59.3 billion Euro annually** owing to the nuclear industry activities

Figure 19 - Impact on disposable household income, 2025 – 2050



Source: Deloitte calculations

Figure 20 - Household income multiplier, 2025 - 2050



1 Euro of direct impact generated due to the nuclear industry will create 2.9 Euro of disposable household income throughout the EU, translating into a total impact of 3.9 Euro.

By 2050, **every** Euro of household income **generated** due to the nuclear industry will sustain overall **3.9 Euro** of household income throughout the EU-27

Source: Deloitte calculations

Impact on public revenues

The overall yearly impact of the nuclear industry on **public revenues** will amount to **71.9 billion Euro**

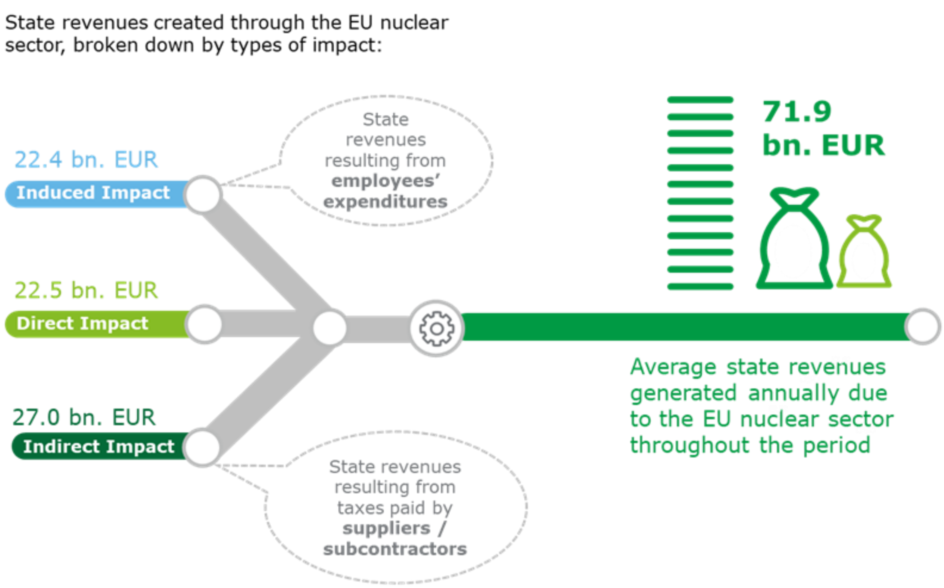
Taxes deriving from the EU-27 nuclear sector activity will significantly contribute to the national budgets of the European Union. For the period 2025–2050, total impact on public revenues generated through the nuclear industry will reach **71.9 billion Euro** every year.

Tax contributions represent a direct support regarding state expenditures and facilitate budget tasks like development of infrastructure, education and healthcare.

The additional economic output created by the nuclear industry generates jobs and higher wages, which will translate into higher tax collections and, subsequently, an increase in public revenue

The direct impact that the nuclear industry has on state revenues through tax contributions will amount to **22.5 billion Euro. The indirect** impact will amount to **27.0 billion Euro** and the **induced impact** will amount to **22.4 billion Euro.** Additionally, the effects on the economy through the expenditures of the operators' and suppliers' employees, predominantly consisting of VAT are included in the indirect and induced impact mentioned above.

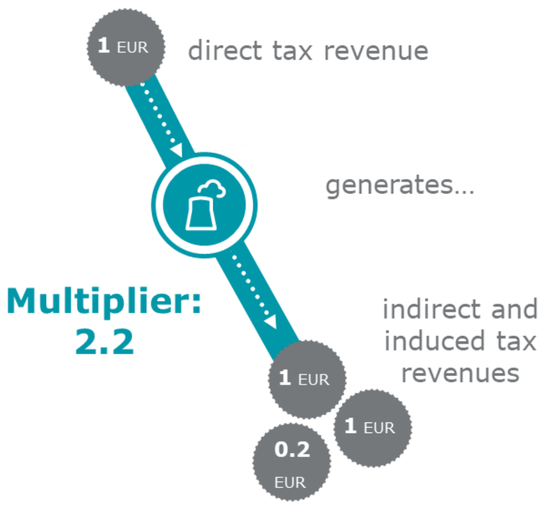
Figure 21 - Impact on public revenues, 2025 – 2050



Source: Deloitte calculations

By 2050, **every Euro** of taxes paid from the nuclear industry will generate **additional public revenues of 2.2 Euro**

Figure 22 - Public revenues multiplier, 2025 - 2050



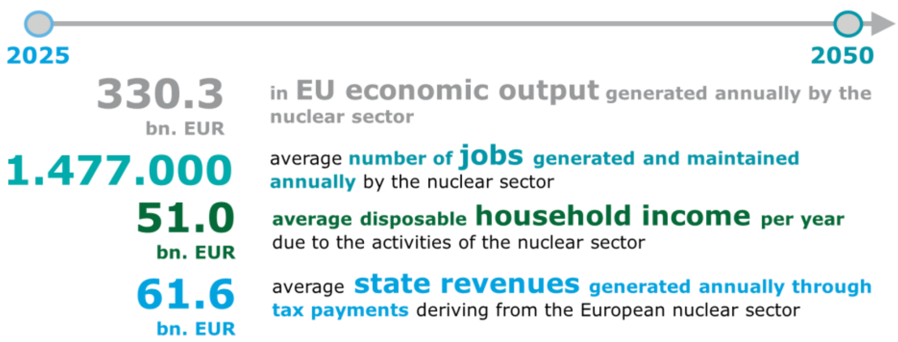
1 Euro direct tax payment in the European nuclear industry will account for **2.2 Euro** in indirect tax payments, resulting in an overall **3.2 Euro** on public revenues.

Source: Deloitte calculations

Economic effects in the #150GW capacity scenario

The figure below depicts the economic benefits resulting from the impact assessment for the #150GW Scenario. Its deployment would generate **330.3 billion Euro** in the EU-27 economic output, would sustain annually **1,477,000 jobs** on average and could generate **61.6 billion Euro** public revenues and **51.0 billion Euro** of disposable household income, respectively.

Figure 23 - Economic effects in the #150GW Scenario, 2025 - 2050



Source: Deloitte calculations

Contribution to a sustainable economic growth in the EU – Impact comparison for two future scenarios

The #100GW Scenario indicates the economic effects deriving from a low nuclear setting in the future, with 100 GW installed capacity by 2050. The #100GW Scenario serves as a reference point for the impact assessment. The **deployment of the #200GW nuclear capacity scenario would lead to the amplification of positive effects** and benefits in all of the analysed impact areas throughout the 2025 – 2050 period. Compared to the #150GW Scenario, the indicators EU economic output, job creation, household incomes and state revenues would see a significant increase in the #200GW Scenario.

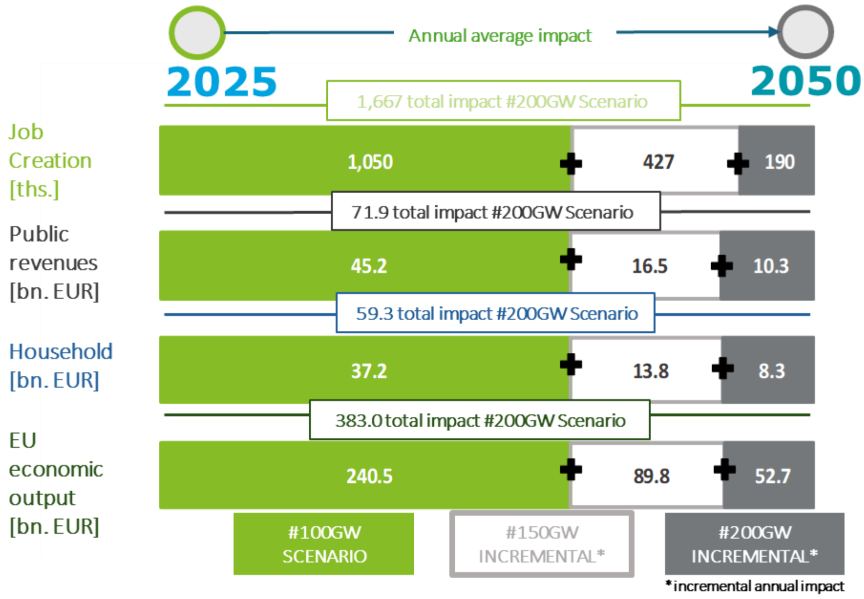
Compared to the #150GW Scenario, the impact on employment would see an **increase by 190,000 jobs every year**, if the #200GW scenario would be deployed**.** What is more, economic output contribution of the nuclear industry would amount to **additional** 52.7 **billion Euro annually**, while household incomes of Europeans would rise by **8.3 billion Euro** annually throughout the period.

Compared to the #100GW Scenario, future benefits of the #200GW Scenario are even more decisive. More details on the incremental impacts of the #200GW and #150GW Scenarios are provided on the following pages.

The figure below depicts the summary of economic benefits of both the #150GW and #200GW Scenarios, emphasizing the annual incremental impact that these scenarios would have throughout the 2025 – 2050 period, compared to the #150GW Scenario.

Compared to the **#150GW** Scenario, the deployment of the **#200GW nuclear capacity scenario** would lead to the **amplification of positive effects** throughout the EU-27

Figure 24 - #100GW Scenario and incremental impact of #150GW and #200GW Scenario, 2025 – 2050



Source: Deloitte calculations

In the **#200GW** Scenario, **190,000 additional jobs** would be sustained every year, compared to **#150GW** Scenario

Impact on EU-27 economic output

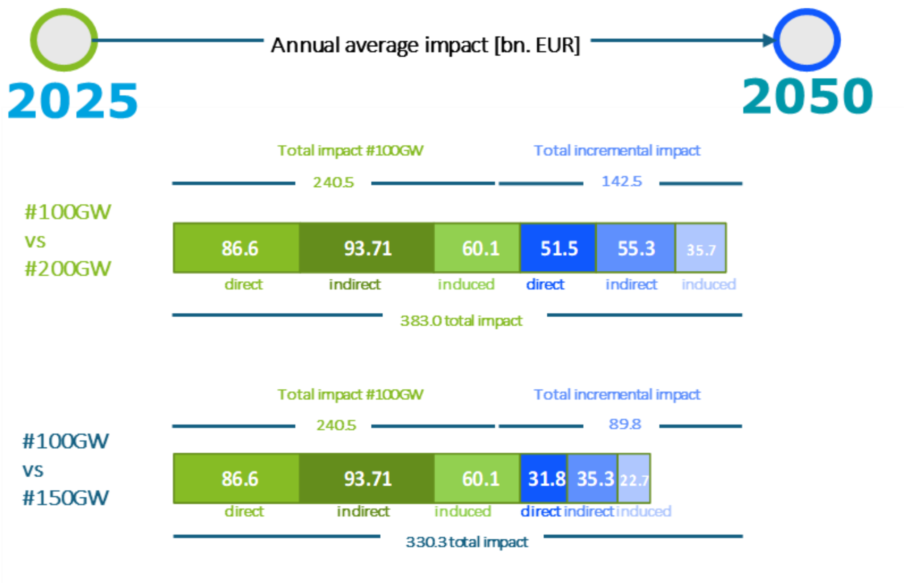
Comparing the #200GW and #150GW Scenarios to the #100GW Scenario, additional economic benefits will be substantial in the future.

The deployment of the #200GW Scenario would generate an annual incremental impact of **142.5 billion Euro** throughout the period, divided into an additional direct impact of 51.5 billion Euro, indirect impact of 55.3 billion Euro and induced impact of 35.7 billion Euro, compared to the #100GW Scenario. This yearly incremental impact would translate into an **overall incremental impact of nearly 4 trillion Euro on the EU-27 economic output** generated due to the deployment of the #200GW Scenario throughout the period, being added to the #100GW Scenario. Overall, the #200GW Scenario would account for a cumulated impact of no less **than 10 trillion Euro** during the upcoming 25 years.

The deployment of the **#200GW Scenario** would entail an overall incremental impact on **economic output** of nearly **4 trillion Euro** during the next 25 years

On the other hand, the deployment of the #150 GW Scenario would lead to a reduction of economic output impact by 52.7 billion Euro every year compared to the #200GW Scenario. For the whole period, this would translate into a total reduction of 1.3 trillion Euro in the EU-27 economic output.

Figure 25 – EU-27 economic output impact, #100GW, #200GW and #150 Scenario, 2025 – 2050



Source: Deloitte calculations

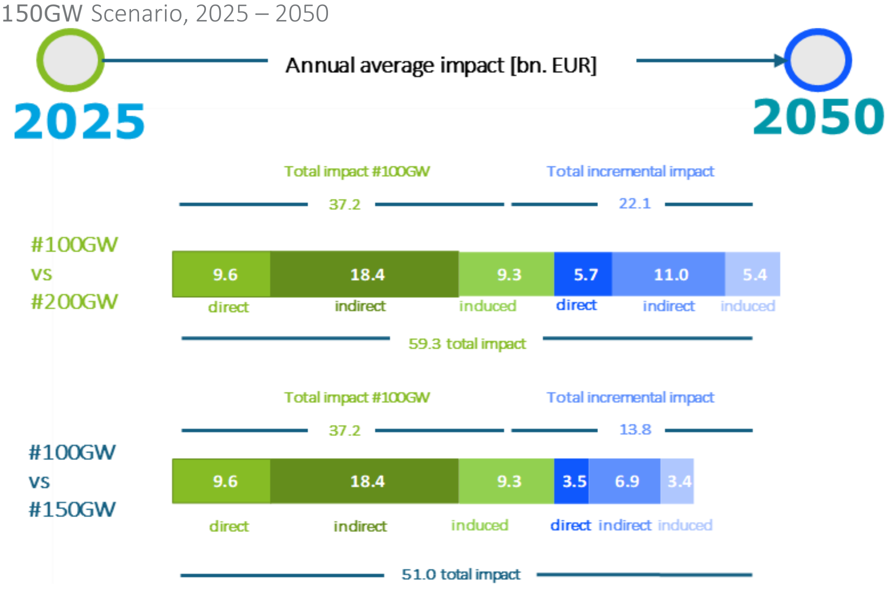
Impact on disposable household income

In the #200GW Scenario, EU-27 household incomes would increase by **22.1 billion Euro** on an annual basis, compared to the #100GW Scenario. The direct incremental impact will amount to 5.7 billion Euro, whereas the additional indirect and induced impact will be 11.7 billion Euro, respectively 5.4 billion Euro, every year. To put it differently, the resulting **incremental impact would rise to a total of 0.6 trillion Euro** over the time span of the upcoming 25 years, compared to the #100GW Scenario. Subsequently, the total impact of the nuclear industry on European household incomes would reach a cumulated amount of **1.5 trillion** Euro over the period 2025 – 2050.

In contrast, the deployment of the #150GW Scenario would involve a significant decrease of future household incomes. An annual shortfall of 8.3 billion Euro would result in a total impact reduction of 0.2 trillion Euro over the period.

Due to the nuclear industry, the incremental impact on EU-27 household income could rise by **overall 0.6 trillion Euro** throughout the period

Figure 26 – Impact on disposable household income, #100GW, #200GW and #150GW Scenario, 2025 – 2050



Source: Deloitte calculations

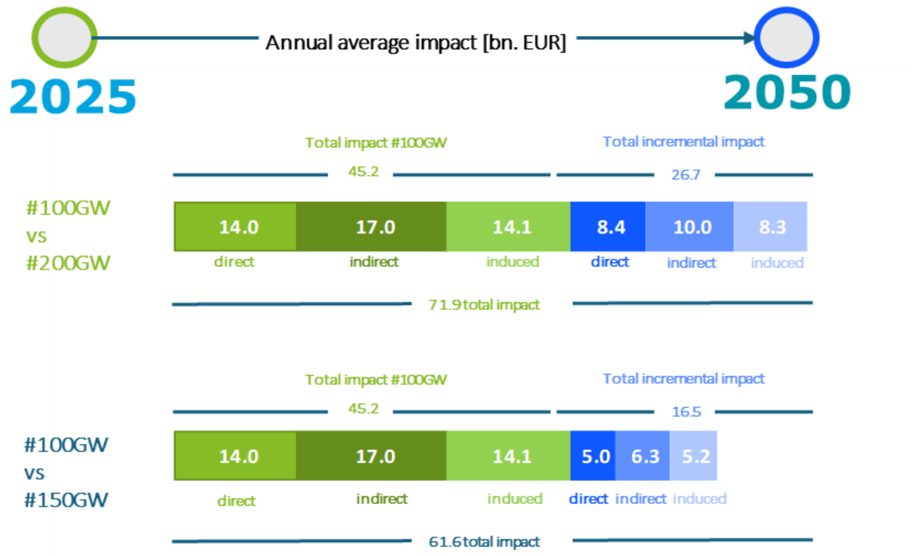
Impact on public revenues

As the figure below shows, the deployment of the #200GW Scenario with a nuclear capacity of 200 GW would entail an additional annual impact of **26.7 billion Euro** on public revenues in the EU-27, divided into 8.4 billion Euro direct, 10.0 billion Euro indirect impact and an induced impact of 8.3 billion Euro on annual public revenues, compared to the #100GW Scenario. This results in an incremental impact of **0.7 trillion Euro** or a cumulated impact of **1.8 trillion Euro public revenues** in Europe in the course of the upcoming 25 years.

In the #200GW scenario, the incremental impact on EU-27 public revenues would rise to **overall 26.7 billion Euro** every year

On the other hand, in the #150GW Scenario compared to the #200GW Scenario, the incremental impact would shrink by 10 billion Euro every year, totalling a reduction of 255 billion Euro in state revenues throughout the analysed period.

Figure 27 - Impact on public revenues, #100GW, #200GW and #150GW Scenario, 2025 – 2050



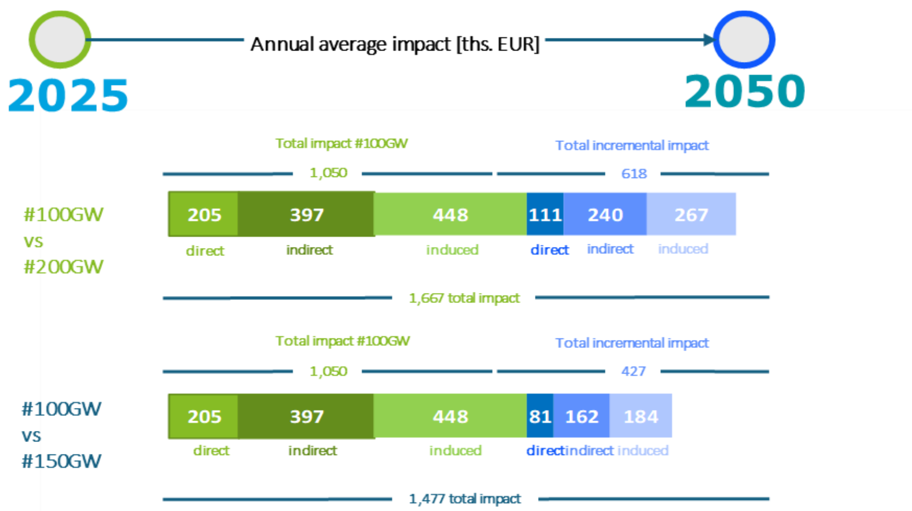
Source: Deloitte calculations

Impact on employment

The nuclear industry could have a substantial contribution to the creation and security of jobs. Through the deployment of the #200GW Scenario, the industry could sustain an additional number of 111 thousand direct, 240 thousand indirect and 267 thousand induced employees every year, compared to #100GW Scenario. This translates into an annual contribution to the labour force market amounting to **618 thousand jobs**. Subsequently, the cumulated incremental impact on employment is substantial.

In contrast, employment figures would see a significant decline in the #150GW Scenario compared to the #200GW Scenario, shrinking by 191 thousand jobs per year.

Figure 28 - Impact on employment, #100GW, #200GW and #150GW Scenario, 2025 – 2050



Source: Deloitte calculations

Impact comparison of labour-intensive energy sectors

For a benchmarking purpose, the impact analysis has been extended with comparisons between two other sectors of the energy industry that provide a significant number of jobs in the national economies. The expectation was that the present study will have the same order of magnitude with other impact studies, for indicators like installed capacity [GW], employment [jobs/ year].

The chosen energy sectors were wind, biogas and solar photovoltaic energy. Being also energy sources with a low carbon footprint, it made the comparison even more relevant.

Based on this comparison, the main conclusion that can be drawn is that **the nuclear sector provides more jobs per installed GW.**

The International Renewable Energy Agency presents in its 2024 study "Renewable Energy and Jobs", that in 2023, the 217 GW [35] installed capacity in **wind** sustained annually **282,000 direct and indirect jobs**[36] in EU-27, whereas the installed capacity of 12 GW[37] in **biogas** sustained annually **49,000 direct and indirect jobs**. Moreover, in **solar photovoltaic** an installed capacity of 255 GW[38]sustained annually **720,000 direct and indirect jobs**

The present study shows that the EU-27 nuclear sector had a net installed power of 106 GW in 2023 and an average of **498,023 direct and indirect jobs**.

Compared to the wind, biogas and solar photovoltaic sectors, nuclear accounts for a higher impact on job creation.

When broken down into 1 GW of installed capacity, the scale of jobs effects the nuclear industry would have in the EU-27 becomes even more distinct. In 2023, 1 GW of installed nuclear capacity would translate into 5,064 jobs sustained in the EU-27 labour market, compared to the biogas and wind sectors where the number of jobs created was 1,294 in the case of wind sector and 4,455 on the biogas sector and 2,825 on the solar photovoltaic sector for 1 GW. Please consult the figure below for an overview of the job effects of the nuclear, wind and biogas sectors in 2023.

In 2023, the impact of the nuclear industry on job creation in the EU it is almost **double** than the impact of the EU wind sector and even **ten times higher** than the impact of the biogas sector

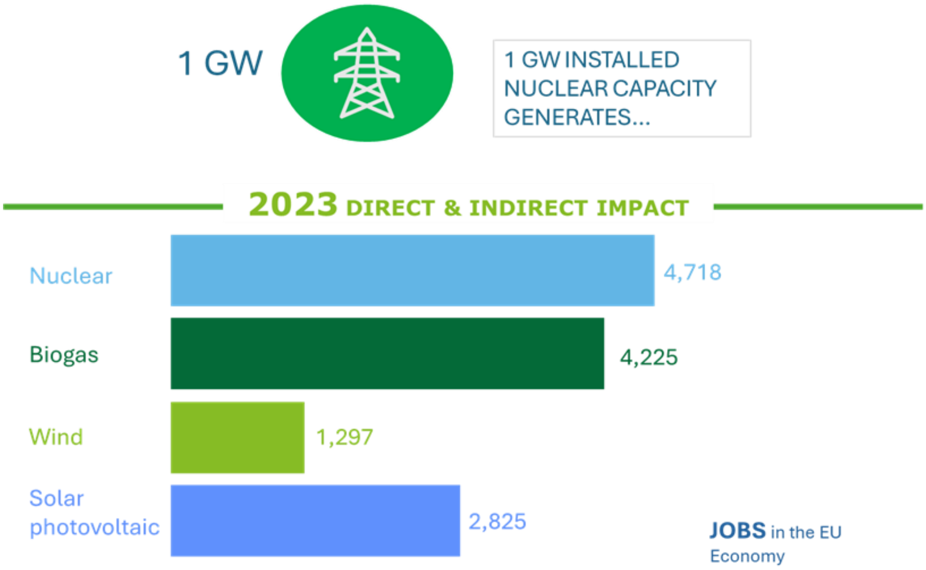
35 Statista – "Cumulative wind power capacity in the European Union (EU-27) as of 2023, by country"

36 International Renewable Energy Agency, Renewable Energy and Jobs

37 International Renewable Energy Agency, "Renewable Energy Statistics 2024"

38 https://www.solarpowereurope.org/insights/outlooks/eu-solar-jobs-report-2024

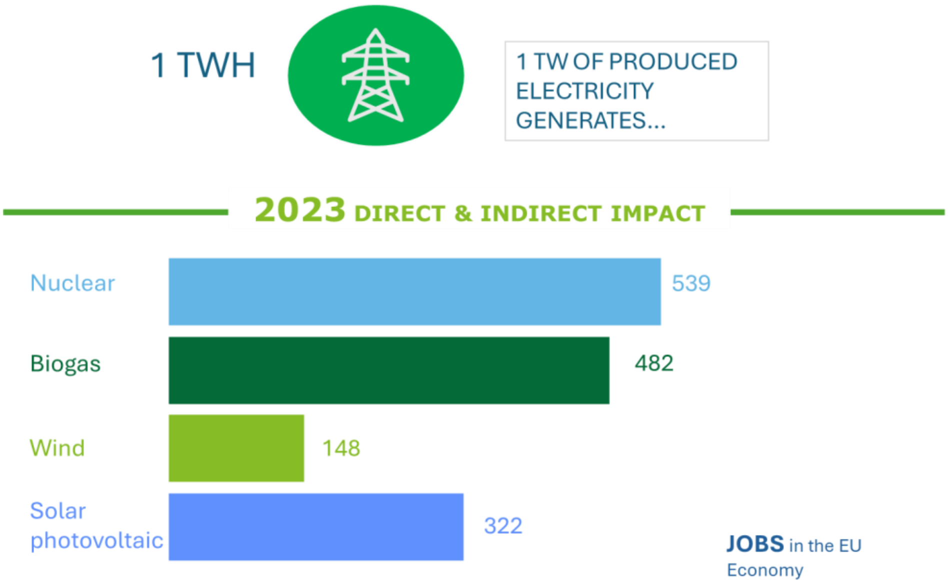
Figure 29 - Impact of 1 GW installed capacity on employment, nuclear, wind, biogas and solar photovoltaic, 2023



Source: Deloitte analysis

An alternative approach of comparing energy sectors would be to assess the impact of one TWh of produced electricity on the jobs created. Please consult the figure below to see the impact of one TWh produced energy on the employment by 2023.

Figure 30 - Impact of 1 TWh produced electricity on employment, nuclear, wind, biogas and solar photovoltaic, 2023



Source: Deloitte analysis

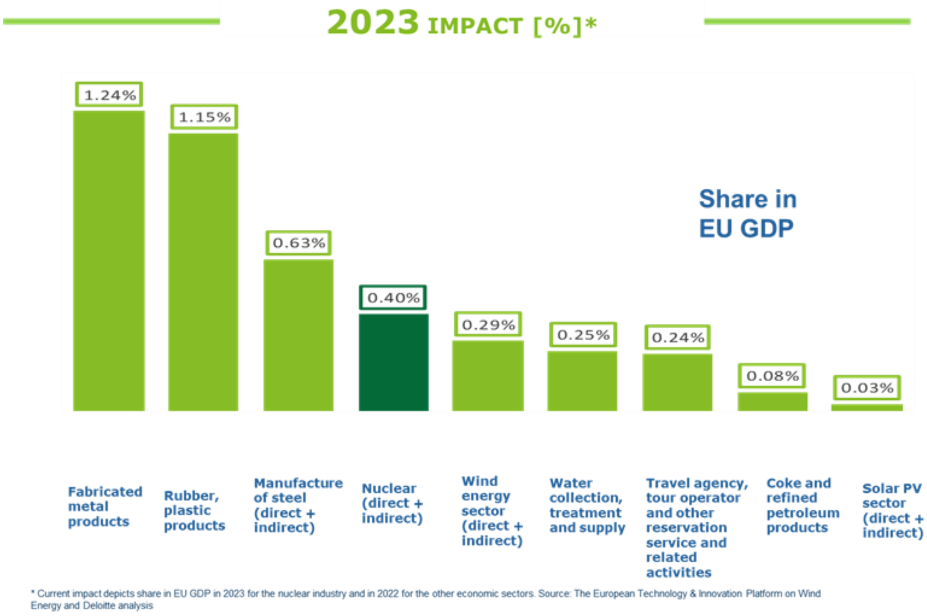
Benchmark with other economic sectors[39]

The nuclear industry accounted for a share of 0.40% in the 2023 EU GDP, totalling 68.5 billion Euro. Compared to other sectors, the share is significant. For example, 1.24% of

39 European technology and innovation platform on wind energy

the total value of goods and services produced in the EU in 2022 derived from the fabricated metal products, whereas the rubber plastic products industry accounted for a share of 1.15% in EU GDP in 2022, while other renewable energy sectors such as wind and solar had a smaller impact on total GDP.

Figure 31 - Benchmark economic sectors, current share in EU GDP



Source: European technology and innovation platform on wind energy, Deloitte analysis

V. Closing remarks

How could the impact of the nuclear industry on the EU-27 economy evolve until 2050, and which of the capacity scenarios would help establish a sustainable growth of the EU economy until 2050?

The primary objective of the present study was to analyse the contribution of the nuclear sector to the overall economy of the EU-27. The study outlined the current economic and social benefits throughout the EU-27 and gave a measurable outlook on the future benefits in the upcoming 25 years based on a comprehensive methodology – the Input-Output-Model

Moreover, the study provides a detailed examination and comparison of the different future capacity scenarios. Impact results indicate that the deployment of a #200GW Scenario with a nuclear capacity of 200 GW would enable the nuclear industry to have a more significant contribution to the European economy and beyond.

Second, the study argues for a sequenced transition from the current situation (106 GW of installed nuclear capacity in the EU-27) to the development of 200 GW by 2050. The #200GW scenario has a significantly greater impact than the #100GW and #150GW scenarios, resulting in a total impact of 383.0 billion on the total economic output. The nuclear sector would generate an average of 1,667,000 jobs per year in the EU-27, with an average disposable household income of EUR 59.3 billion and state revenues of EUR 71.9 billion through tax payments.

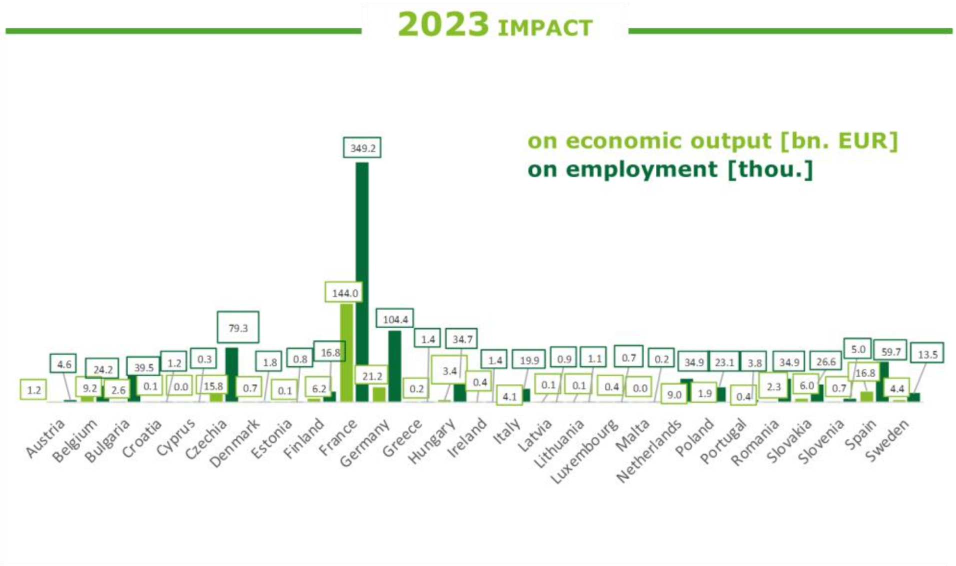
One of the key aims of this study was to provide a framework for measuring the future benefits generated by the EU nuclear industry in the 2025–2050 period, under the three scenarios of with 100 GW, 150 GW and 200 GW installed capacities. The decision-makers now have access to a reliable forecast of the benefits that would be derived from the deployment of a 200 GW nuclear power capacity throughout the Europe, while the results are dependent on the construction plan of the new nuclear reactors.

Appendix

Disaggregated impact assessment

For a detailed view on the current contribution of the nuclear industry on the economy of the 27 member states of the European Union, please consult the figure below. Moreover, please consider the following two subchapters for a slit on countries with and without nuclear capacities, as well.

Figure 32 - Impact on economic output and employment in the EU-27 countries



Source: Deloitte calculations

Countries with current nuclear capacities

The table below shows the current impact of the nuclear power sector on economic output, employment, state revenues and disposable household income in the national economies of the 12 EU-27 member states with nuclear power capacities.

Table 6 - Impact in EU-27 countries with nuclear reactors in operation, 2023

	Employment [thou.]	Economic output [bn. EUR]	Household income [bn. EUR]	Public revenues [bn. EUR]
Belgium	24.2	9.2	1.5	1.9
Bulgaria	39.5	2.6	0.3	0.3
Czechia	79.3	15.8	1.2	2.3
Finland	16.8	6.2	0.9	1.3
France	349.2	144.0	22.1	28.2
Hungary	34.7	3.4	0.6	0.5
Netherlands	34.9	9.0	1.7	2.0

	Employment [thou.]	Economic output [bn. EUR]	Household income [bn. EUR]	Public revenues [bn. EUR]
Romania	34.9	2.3	0.3	0.3
Slovakia	26.6	6.0	0.5	0.7
Slovenia	5.0	0.7	0.1	0.1
Spain	59.7	16.8	2.1	2.6
Sweden	13.5	4.4	0.8	1.1

Source: Deloitte calculations

The following figures show the disaggregated results of the current impact of the nuclear industry in the EU-27 member states with nuclear power capacities. The figures include the split between direct, indirect and induced impact[40] for the selected indicators: impact on economic output, employment, disposable household income and state revenues.

Table 7 - Belgium: Direct, indirect and induced impact, 2023

Belgium	Direct impact	Indirect impact	Induced impact
Employment [thous.]	4.5	13.4	8.8
Economic Output [bn. EUR]	4.4	3.9	2.2
Household income [bn. EUR]	0.5	0.8	0.3
Public revenues [bn. EUR]	0.8	0.7	0.4

Source: Deloitte calculations

Table 8 - Bulgaria: Direct, indirect and induced impact, 2023

Bulgaria	Direct impact	Indirect impact	Induced impact
Employment [thous.]	20.0	23.5	36.9
Economic Output [bn. EUR]	1.9	1.2	1.2
Household income [bn. EUR]	0.2	0.2	0.2
Public revenues [bn. EUR]	0.1	0.1	0.1

Source: Deloitte calculations

Table 9 - Czech Republic: Direct, indirect and induced impact, 2023

Czechia	Direct impact	Indirect impact	Induced impact
Employment [thous.]	13.8	41.8	27.8
Economic Output [bn. EUR]	8.1	5.6	2.6
Household income [bn. EUR]	0.3	0.9	0.0
Public revenues [bn. EUR]	1.1	0.8	0.4

Source: Deloitte calculations

40 Impact figures are rounded to one decimal.

Table 10 - Spain: Direct, indirect and induced impact, 2023

Spain	Direct impact	Indirect impact	Induced impact
Employment [thous.]	2.9	27.5	33.5
Economic Output [bn. EUR]	5.2	8.0	4.7
Household income [bn. EUR]	0.2	1.2	0.8
Public revenues [bn. EUR]	0.6	1.1	1.0

Source: Deloitte calculations

Table 11 – France: Direct, indirect and induced impact, 2023

France	Direct impact	Indirect impact	Induced impact
Employment [thous.]	59.7	136.0	158.7
Economic Output [bn. EUR]	57.0	56.8	31.5
Household income [bn. EUR]	6.1	10.9	5.4
Public revenues [bn. EUR]	9.2	10.6	8.4

Source: Deloitte calculations

Table 12 - Hungary: Direct, indirect and induced impact, 2023

Hungary	Direct impact	Indirect impact	Induced impact
Employment [thous.]	8.5	13.7	14.7
Economic Output [bn. EUR]	1.7	1.1	0.9
Household income [bn. EUR]	0.2	0.2	0.2
Public revenues [bn. EUR]	0.3	0.2	0.1

Source: Deloitte calculations

Table 13 - Netherlands: Direct, indirect and induced impact, 2023.

Netherlands	Direct impact	Indirect impact	Induced impact
Employment [thous.]	0.3	22.7	14.1
Economic Output [bn. EUR]	0.3	6.6	2.7
Household income [bn. EUR]	0.0	1.4	0.4
Public revenues [bn. EUR]	0.1	1.4	0.6

Source: Deloitte calculations

Table 14 - Romania: Direct, indirect and induced impact, 2023

Romania	Direct impact	Indirect impact	Induced impact
Employment [thous.]	32.1	30.3	63.5
Economic Output [bn. EUR]	2.5	1.9	2.6
Household income [bn. EUR]	0.4	0.3	0.3
Public revenues [bn. EUR]	0.1	0.1	0.1

Source: Deloitte calculations

Table 15 - Slovenia: Direct, indirect and induced impact, 2023

Slovenia	Direct impact	Indirect impact	Induced impact
Employment [thous.]	1.0	2.3	2.1
Economic Output [bn. EUR]	0.3	0.3	0.2
Household income [bn. EUR]	0.0	0.1	0.0
Public revenues [bn. EUR]	0.1	0.0	0.0

Source: Deloitte calculations

Table 16 - Slovakia: Direct, indirect and induced impact, 2023

Slovakia	Direct impact	Indirect impact	Induced impact
Employment [thous.]	17.2	18.9	14.9
Economic Output [bn. EUR]	3.9	3.2	1.6
Household income [bn. EUR]	0.3	0.4	0.1
Public revenues [bn. EUR]	0.2	0.3	0.1

Source: Deloitte calculations

Table 17 - Finland: Direct, indirect and induced impact, 2023

Finland	Direct impact	Indirect impact	Induced impact
Employment [thous.]	5.1	7.1	6.6
Economic Output [bn. EUR]	2.7	1.8	1.4
Household income [bn. EUR]	0.3	0.4	0.2
Public revenues [bn. EUR]	0.4	0.2	0.2

Source: Deloitte calculations

Table 18 - Sweden: Direct, indirect and induced impact, 2023

Sweden	Direct impact	Indirect impact	Induced impact
Employment [thous.]	4.0	5.8	5.0
Economic Output [bn. EUR]	2.0	1.6	1.2
Household income [bn. EUR]	0.3	0.4	0.2
Public revenues [bn. EUR]	0.5	0.3	0.2

Source: Deloitte calculations

Countries without current nuclear capacities

Even though 15 of the EU-27 member states currently do not have installed nuclear power capacities, there is still an observable footprint of the industry in the economies of those countries. Cross border cooperation and migration of employees lead to an impact on national economic output, employment, disposable household incomes and state revenues, due to the direct, indirect and induced effects.[41] The table below shows the current overall impact of the nuclear power sector on economic output, employment, household incomes, and public revenues in the EU-27 countries without

41 Impact figures are rounded to one decimal.

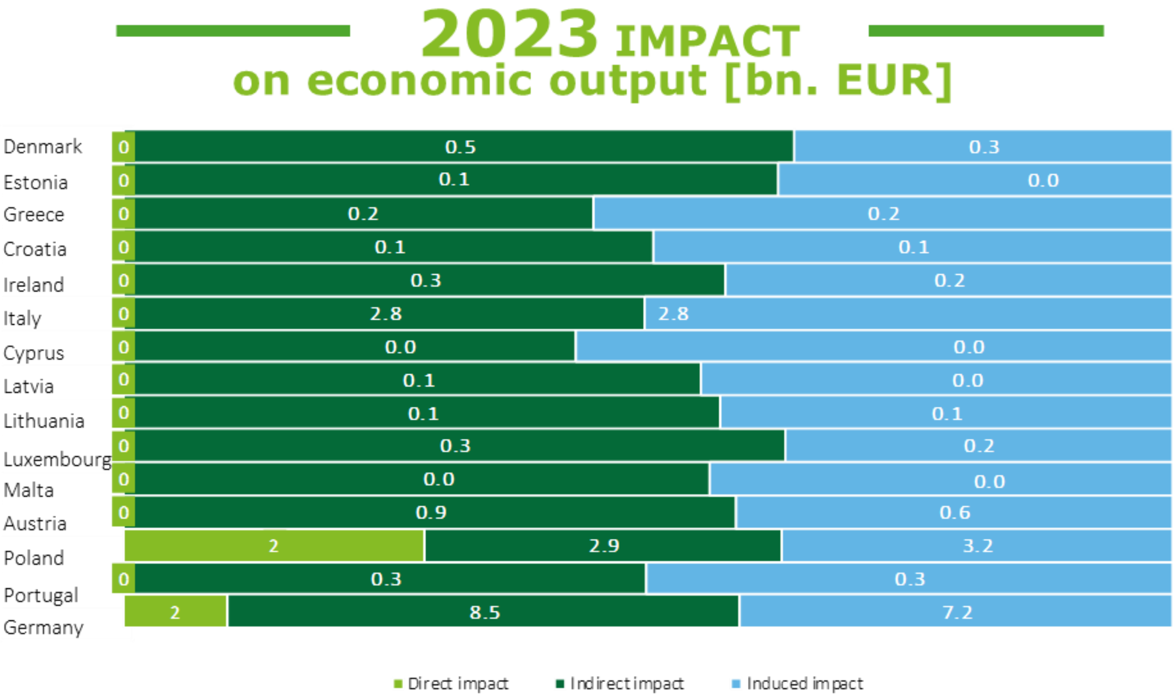
nuclear power capacities. Moreover, please consult Figures 33, 34, 35 and 36 for more information on direct, indirect and induced impacts in the analysed impact areas.

Table 19 - Impact in EU-27 countries without nuclear capacities, 2023

	Employment [thou.]	Economic output [bn. EUR]	Household income [bn. EUR]	Public revenues [bn. EUR]
Austria	4.6	1.2	0.2	0.2
Croatia	1.2	0.1	0.0	0.0
Cyprus	0.3	0.0	0.0	0.0
Denmark	1.8	0.7	0.1	0.2
Estonia	0.8	0.1	0.0	0.0
Germany	104.4	21.2	4.4	4.3
Greece	1.4	0.2	0.0	0.0
Ireland	1.4	0.4	0.1	0.0
Italy	19.9	4.1	0.6	0.8
Latvia	0.9	0.1	0.0	0.0
Lithuania	1.1	0.1	0.0	0.0
Luxembourg	0.7	0.4	0.0	0.0
Malta	0.2	0.0	0.0	0.0
Poland	23.1	1.9	0.3	0.4
Portugal	3.8	0.4	0.1	0.1

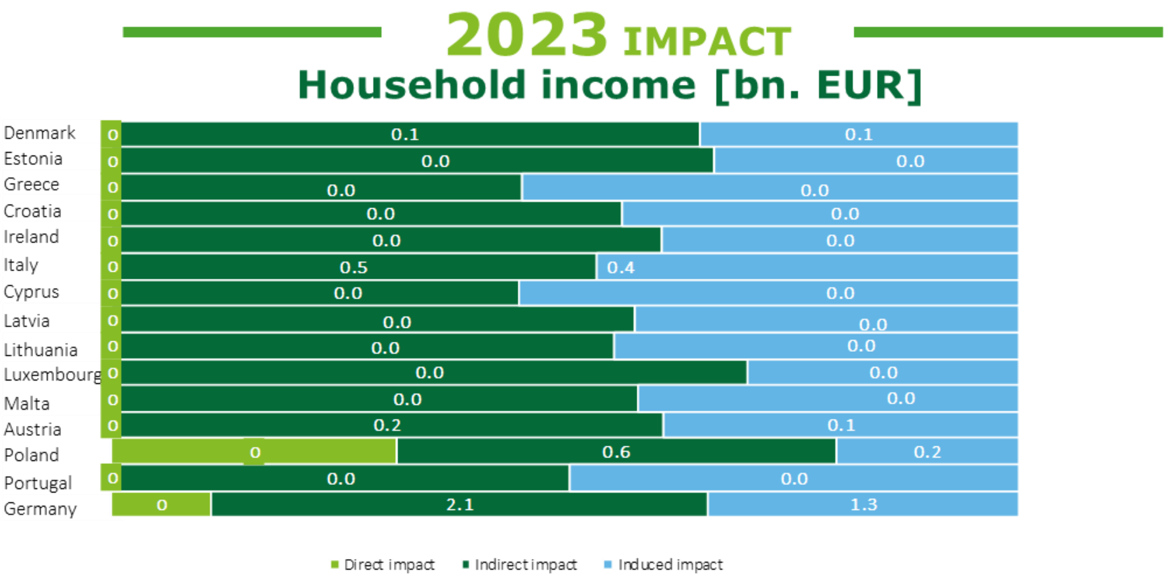
Source: Deloitte calculations

Figure 33 - Direct, indirect and induced impact on economic output countries without nuclear capacities



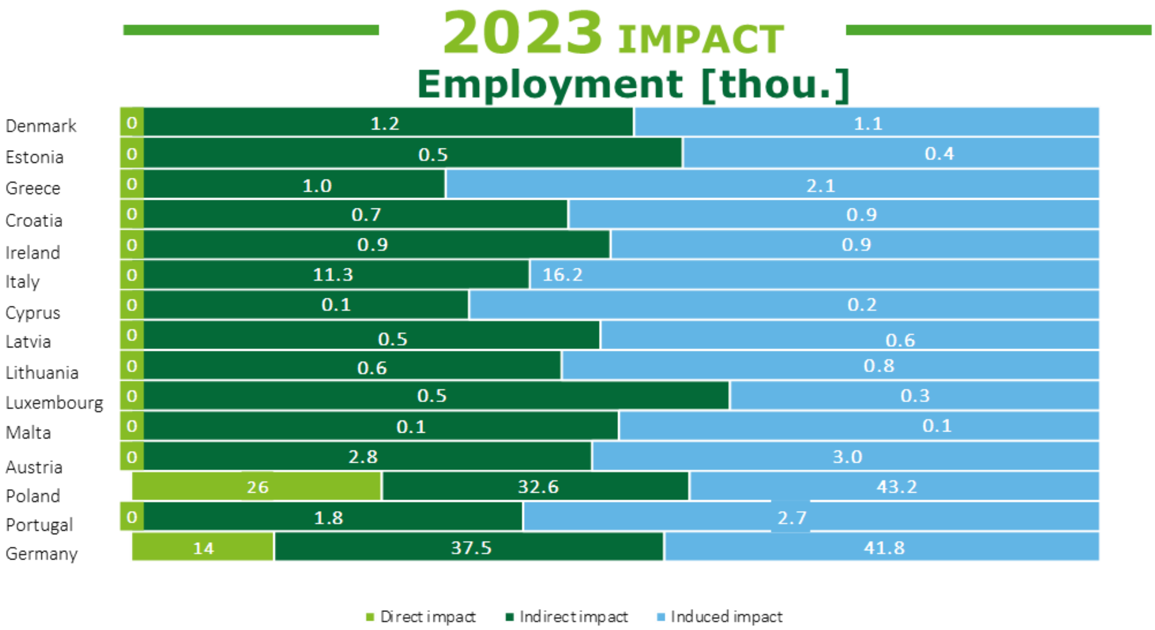
Source: Deloitte calculations

Figure 34 - Direct, indirect and induced impact on household income, countries without nuclear capacities, 2023



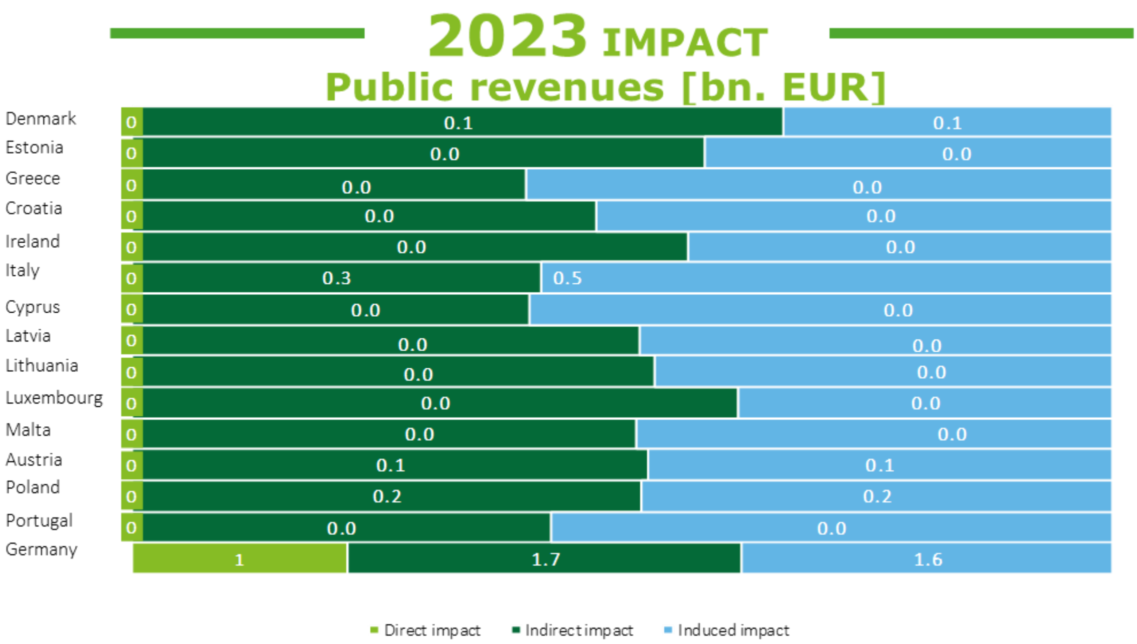
Source: Deloitte calculations

Figure 35 - Direct, indirect and induced impact on Employment and public revenues in countries without nuclear capacities, 2023



Source: Deloitte calculations

Figure 36 - Direct, indirect and induced impact on public revenues in countries without nuclear capacities, 2023



Source: Deloitte calculations

GDP

Table 20 – Impact on GDP % in the 27 EU member states in 2023

GDP (%)	2023
Austria	0.10%
Belgium	0.66%
Bulgaria	1.09%
Croatia	0.05%
Cyprus	0.06%
Czechia	1.97%
Denmark	0.09%
Estonia	0.09%
Finland	1.01%
France	1.92%
Germany	0.24%
Greece	0.04%
Hungary	0.72%
Ireland	0.04%
Italy	0.08%
Latvia	0.07%
Lithuania	0.06%
Luxembourg	0.12%
Malta	0.05%
Netherlands	0.40%
Poland	0.11%
Portugal	0.06%
Romania	0.28%
Slovakia	1.43%
Slovenia	0.50%
Spain	0.41%
Sweden	0.43%

Source:Deloitte analysis

GDP growth

Table 21- GDP growth in the 27 EU member states

GDP growth [%]	2025	2030	2035	2040	2045	2050
Belgium	1,6	1,1	1,2	1,7	1,5	1,3
Bulgaria	2,0	1,7	1,5	1,4	1,3	1,1
Czech Republic	1,8	1,3	1,4	1,6	1,7	1,6
Denmark	1,2	0,9	1,3	1,6	1,7	1,6
Germany	1,0	0,7	1,0	1,6	1,5	1,3
Estonia	1,5	1,4	1,7	2,0	1,8	1,6
Ireland	5,5	3,3	1,8	1,7	1,3	1,2
Greece	1,4	0,6	0,6	1,1	1,2	1,1

GDP growth [%]	2025	2030	2035	2040	2045	2050
Spain	1,5	0,8	1,0	1,6	1,4	1,3
France	0,8	0,6	0,8	1,5	1,4	1,3
Croatia	2,5	1,5	1,4	1,7	1,5	1,4
Italy	1,0	0,6	0,8	1,4	1,4	1,4
Cyprus	2,4	1,6	1,6	1,9	1,8	1,5
Latvia	2,1	1,4	1,5	1,2	0,8	0,4
Lithuania	2,6	1,5	1,4	1,2	1,0	0,6
Luxembourg	2,3	1,6	1,7	2,2	2,1	1,8
Hungary	2,5	2,1	1,8	1,6	1,7	1,7
Malta	3,9	3,8	3,2	2,5	1,9	1,3
Netherlands	1,5	0,8	1,0	1,6	1,7	1,6
Austria	1,4	1,3	1,3	1,6	1,4	1,2
Poland	2,4	2,2	2,1	1,4	1,0	0,9
Portugal	1,6	0,7	0,7	1,2	1,3	1,4
Romania	2,7	2,3	2,0	1,4	1,3	1,3
Slovenia	2,7	2,2	2,0	1,5	1,1	1,0
Slovakia	1,6	1,6	1,7	1,5	1,4	1,3
Finland	1,1	1,0	1,2	1,5	1,3	1,1
Sweden	1,7	1,5	1,7	2,0	1,8	1,6

Source: European Commission 2024b

Nuclear capacities

Table 22 - Nuclear capacities in the 27 EU member states

Nuclear capacities in 2023 [MW]	
Total	**105,553**
Austria	-
Belgium	5,151
Bulgaria	2,080
Croatia	-
Cyprus	-
Czechia	4,164
Denmark	-
Estonia	-
Finland	4,622
France	64,040
Germany	4,291
Greece	-
Hungary	2,027
Ireland	-
Italy	-
Latvia	-

Nuclear capacities in 2023 [MW]	
Lithuania	-
Luxembourg	-
Malta	-
Netherlands	515
Poland	-
Portugal	-
Romania	1,411
Slovakia	2,000
Slovenia	727
Spain	7,408
Sweden	7,117

Source: Client information, Deloitte analysis

Nuclear reactors

Table 23 - Nuclear reactors in the 27 EU member states

Nuclear reactors currently in operation	
Total	**100**
Austria	-
Belgium	6
Bulgaria	2
Croatia	-
Cyprus	-
Czechia	6
Denmark	-
Estonia	-
Finland	5
France	56
Germany	-
Greece	-
Hungary	4
Ireland	-
Italy	-
Latvia	-
Lithuania	-
Luxembourg	-
Malta	-
Netherlands	1
Poland	-
Portugal	-
Romania	2

Nuclear reactors currently in operation	
Slovakia	4
Slovenia	1
Spain	7
Sweden	6

Source: Client information, Deloitte analysis

Methodological notes

This part contains detailed description of the use of input-output tables for impact analysis[42].

Input-Output coefficients

Output coefficients can be interpreted as the shares in total output (revenue) or market shares for commodities and primary inputs. For value added, it reflects the distribution of primary inputs. The output coefficients are calculated by dividing each entry of the input-output table by the corresponding row total.

Static input-output model

A well-known input-output model is the static input-output system of Wassily Leontief. It is a linear model, which is based on Leontief production functions and a given vector of final demand. The objective is to calculate the unknown activity (output) levels for the individual sectors (endogenous variables) for the given final demand (exogenous variables).

In the following example, we are presenting this basic model for an economy with 3 sectors.

The balance between total input and outputs can be described by the following set of equations:

Definition equations:

$x_{11} + x_{12} + x_{13} + x_{1d} = x_1$

$x_{21} + x_{22} + x_{23} + x_{2d} = x_{2*}$

$x_{31} + x_{32} + x_{33} + x_{3d} = x_3$

$_{ij}$ = intermediates from sector *i* to sector *j*

$_{id}$ = final demand for commodity *i*

x_j = output of sectors *j*

We assume that all sectors produce with linear Leontief production functions. All inputs (intermediates, capital, labour, land) are used in fixed proportions in relation to output.

42 European Commission (2008)
The Scottish Government Input-Output team (2015)

It is assumed that a substitution of inputs is impossible. Therefore, changing factor prices have no influence on the technical input coefficients.

Input coefficients for domestic intermediates:

$a_{ij} = x_{ij}/x_j$

The requirements for intermediates can be defined as the set of input coefficients weighted with the corresponding output level.

Requirements for intermediates:

$x_{ij} = a_{ij}\, x_j$

If we accept the assumption that the sectors produce with fixed technical input coefficients, the equation system above can be rewritten by replacing x_{ij} by $a_{ij}\, x_j$. These equations serve to make explicit the dependence of interindustry flows on the total output of each sector.

Input-Output System:

$a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + x_{1d} = x_1$

$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + x_{2d} = x_2$

$a_{31}x_1 + a_{32}x_2 + a_{33}x_3 + x_{3d} = x_3$

This set of equations is transformed into the following Leontief equation system. The equation system has the following features:

- final demand (exogenous variable) is isolated on the right side of the equation;
- net output (output less intersectoral consumption) is identified on the diagonal of the matrix;
- inputs have a negative sign, output have a positive sign;

If the vector of final demand and the technical coefficients are known, the Leontief equation system is simply a set of linear equations with unknown output levels. The objective is to derive the activity levels of industries for the given level of demand.

In matrix terms we define:

$Ax + y = x$

$x - Ax = y$

$(I - A)x = y$

The solution of this linear equation system is:

$x = (I - A)^{-1}\, y$

A = matrix of input coefficients for intermediates (technology matrix)

I = unit matrix

(I - A) = Leontief matrix

(I - A)$^{-1}$ = Leontief inverse

y = vector of final demand

x = vector of output

In the matrix algebra, we denote vectors in small letters and matrices in capital letters. Vector Ax reflects the requirements for intermediates, while vector y represents the exogenous aggregate final demand. The matrix *(I-A)* is called Leontief matrix. On the diagonal of this matrix, the net output is given for each sector with positive coefficients (revenues), while the rest of the matrix covers the input requirements with negative coefficients (costs). The Leontief inverse *(I-A)*$^{-1}$ reflects the direct and indirect requirements for intermediates.

On the diagonal of the Leontief matrix, the net-output of each sector is reported. The other coefficients in the matrix represent input requirements.

The cumulative input coefficients reflect the direct and indirect requirements for domestic intermediates for one unit of final demand.

The inverse can be approximated by the power series of A matrices:

$(I - A)^{-1} = I + A + A^2 + A^3 + ... + A^n$

In this notation of the inverse, the unit matrix *I* denotes, on the diagonal, one unit of the commodity for final demand. Matrix *A* represents the direct input requirements of the producer for intermediates and matrices A^2 until A^n the indirect requirements for intermediates at the previous stages of production. The column sum of the inverse can be interpreted as output multiplier, which reflects the cumulative revenues of the economy, which are induced by one additional unit of final demand of a certain commodity.

The Leontief inverse *(I-A)*$^{-1}$ is multiplied with the vector of final demand to estimate the output levels. This model is often used to study the impact of exogenous changes of final demand on the economy.

Derivation of other multipliers and effects

Income multiplier

$$(\mathbf{I}_{\text{mult}})_j = \sum_i v_i L_{ij} / v_j$$

The income multipliers show the increase in income from employment throughout the economy that results from a unit change of income from employment in each industry. In the formula above, *v* refers to the ratio of income / total output for each industry.

Income effect

$$(\mathbf{I}_{\text{eff}})_j = \sum_i v_i L_{ij}$$

This statistic calculates the impact upon income from employment throughout the economy arising from a change in final demand for industry *j*'s output.

Value added (GVA) multiplier

$$(\mathbf{G}_{\text{mult}})_j = \sum_i g_i L_{ij} / g_j$$

The GVA multipliers show the increase in GVA throughout the economy that result from a unit change of GVA in each industry. In the formula above, *g* refers to the ratio of GVA / total output for each industry.

GVA effects

$$(\mathbf{G}_{\text{eff}})_j = \sum_i g_i L_{ij}$$

This statistic calculates the impact upon GVA throughout the economy arising from a change in final demand for industry *j*'s output.

Employment multiplier

$$(\mathbf{E}_{\text{mult}})_j = \sum_i w_i L_{ij} / w_j$$

The employment multipliers show the total increases in employment throughout the economy which result from an increase in final demand which is enough to create one additional full-time equivalent employment (FTE) in that industry. In the formula above, w is equal to FTE per a unit of total output for each industry. This analysis uses the results of the symmetric table analysis, but additionally requires equivalent employment data.

Employment effects

$$(\mathbf{E}_{\text{eff}})_j = \sum_i w_i L_{ij}$$

The employment effects statistic calculates the impact upon employment throughout the economy arising from a change in final demand for industry j's output.

The main questions for the underlying analysis were:

i) How much spending does the nuclear industry bring to the European Union?
ii) How many jobs does the nuclear industry support in the EU?
iii) How much income is generated for households through the EU nuclear industry?
iv) How much tax revenue is generated by the EU nuclear industry?

These questions translate into four main indicators that were calculated:

Impact on economic output

- **Direct impact:** Impact of nuclear power plants operators' and nuclear supply chain activities on EU economic output
- **Indirect impact**: Suppliers'/ subcontractors' contribution to economic output
- **Induced impact**: Contribution to economic output resulting from employees' expenditure

Impact on job creation

- **Direct impact:** Direct employment in nuclear power plants and the nuclear supply chain

- **Indirect impact:** Jobs created through suppliers' expenditures
- **Induced impact**: Jobs created through suppliers employee

Impact on disposable household income

- **Direct impact:** Disposable household income deriving from the activities of nuclear power plant operators and nuclear supply chain
- **Indirect impact**: Disposable household income generated though suppliers / subcontractors
- **Induced impact**: Disposable household income resulting from employees' expenditures

Impact on public revenues

- **Direct impact:** State revenues generated **directly** due to tax payments from the nuclear power plant operators and nuclear supply chain
- **Indirect impact**: State revenues resulting from taxes paid by suppliers / subcontractors
- **Induced impact**: State revenues resulting from employees' expenditures

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