



Bram Paul Jobse

"Let's use what we have and start building!"

Back to the future

*Yesterday teaches you;
tomorrow gives you a chance*



Reliable – Affordable – Safe – CO₂ neutral electricity

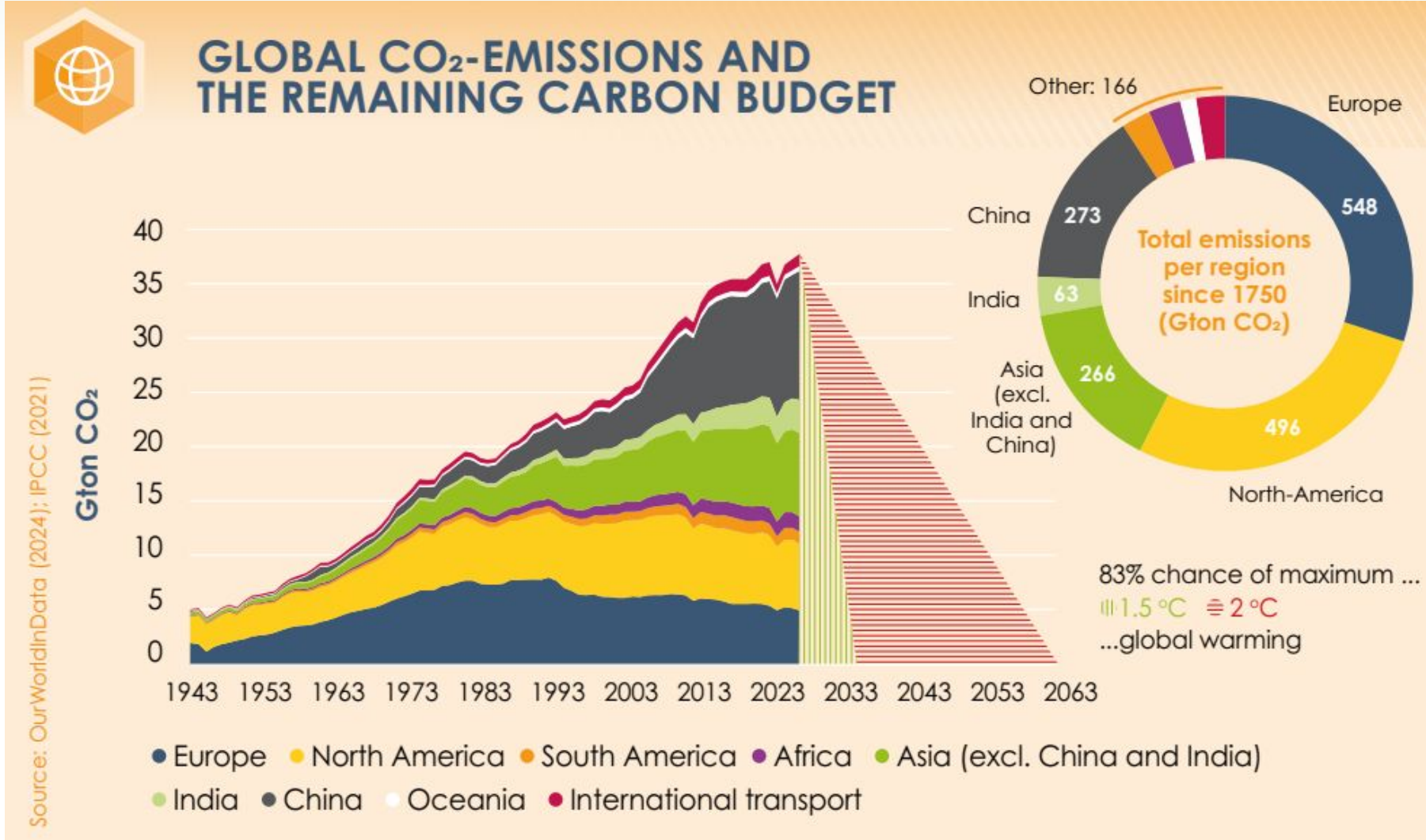
Yesterday teaches you; tomorrow gives you a chance

1. Setting the scene
2. Yesterday
3. Tomorrow

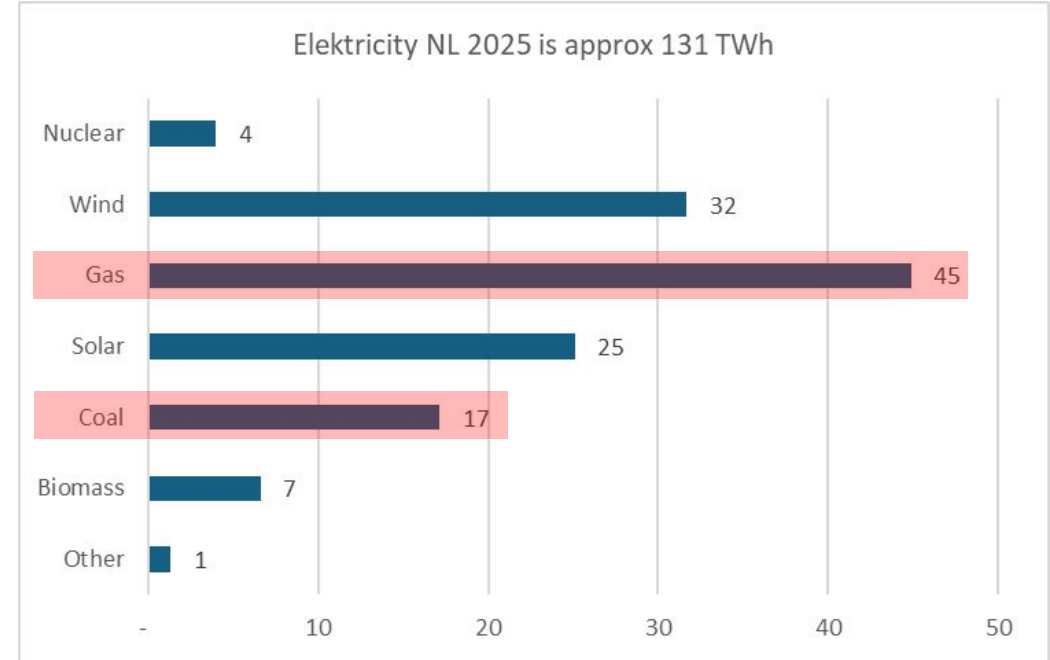
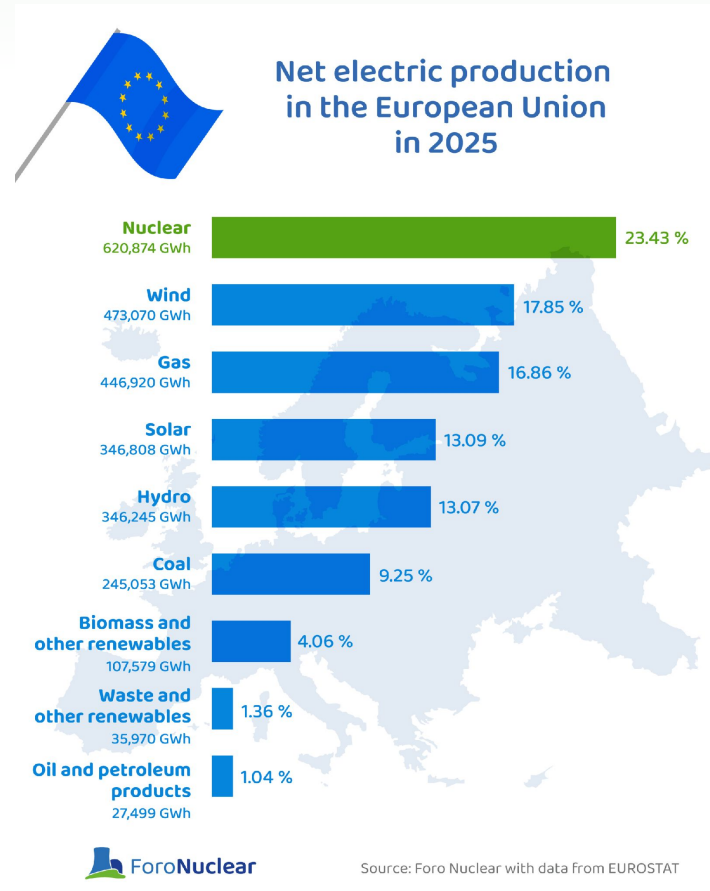
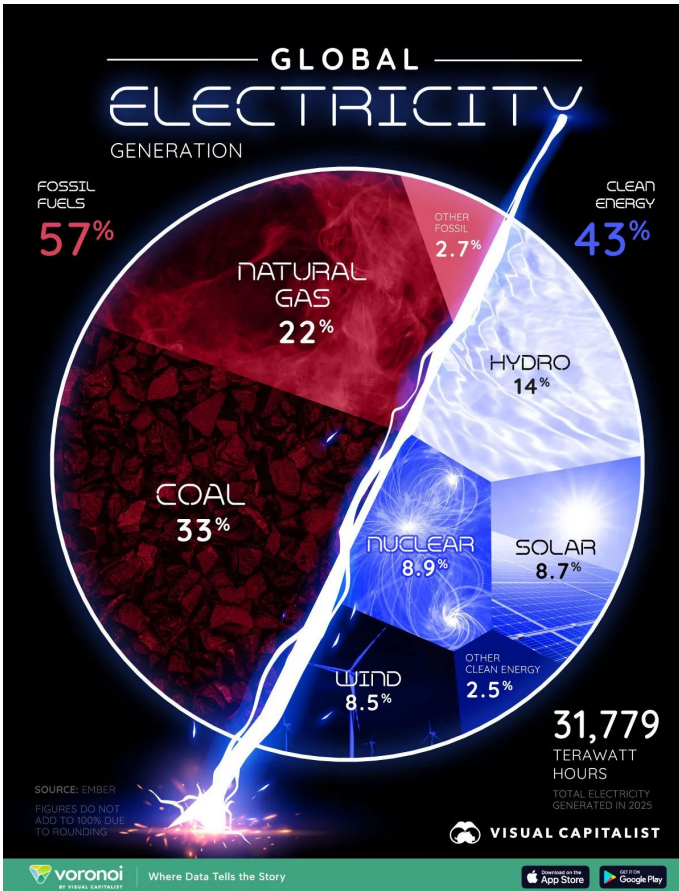
'The thing that has been, it is which shall be; and that which is done is that what shall be done....'

1. Setting the scene

World wide targets



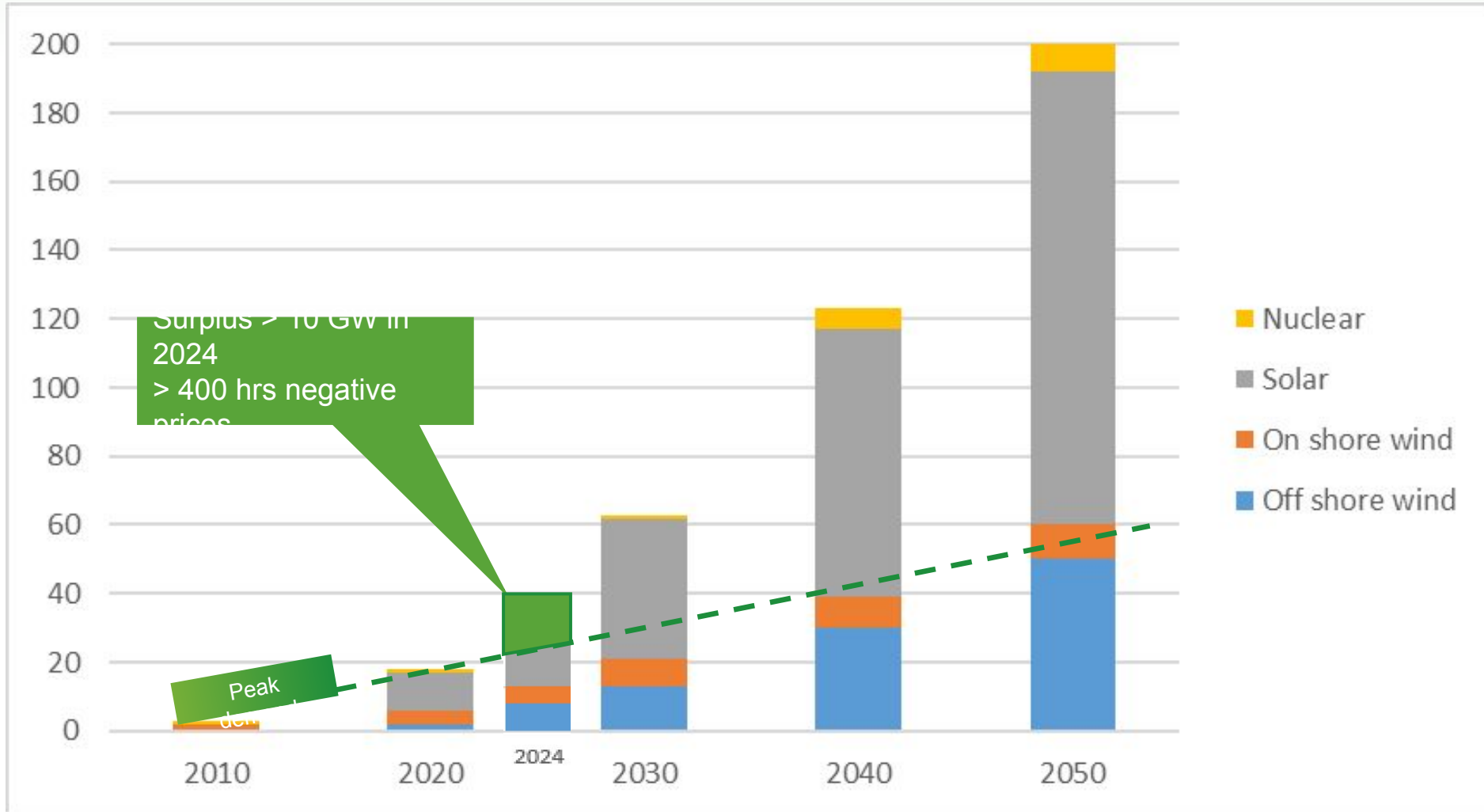
World wide and NL



Replacing gas and coal means 62 TWh = approx. 5 large nuclear power plants

Installed capacity in GW in NL

(How long) will this system work?



The scene

Supply and demand are increasingly out of balance

- Increasing supply at an undesirable time and location.
- Insufficient grid capacity to balance this.
- Growth in demand not in balance with increasing supply.

Nuclear power plants are an important part of the solution

- Carbon free electricity generation when there is no sun and wind.
- Stable continuous production and grid support in a volatile electricity system.
- Limited space requirements.
- SMR developments on industrial sites with available grid connection.

2. Yesterday



This is what vision looks like! - Today: 63 years of experience with the future

How the NL nuclear renaissance started

How the NL nuclear renaissance started

- 06.2020 Minister of Economic Affairs and Climate asks EPZ to investigate life time extension from 60 □ 80 years
- Main questions:
 - Technological feasibility
 - Economical feasibility: investments vs. market (prices)
 - Compliance to safety regulations

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2 JUN 2020

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Ons kenmerk

DGKE-E / 20141901

Uw kenmerk

Bijlage(n)

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Datum 29 MEI 2020
Betreft levensduurverlenging kerncentrale

Geachte heer Wolters,

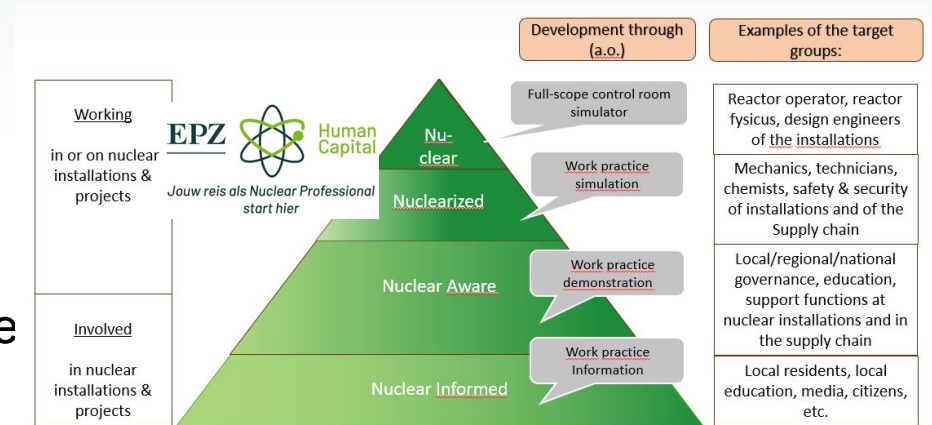
De Provincie Zeeland heeft in haar Regionale Energie Strategie aangegeven dat kernenergie een rol speelt in de Zeeuwse CO₂-vrije energiemix. De minister van Economische Zaken en Klimaat heeft vervolgens in antwoord op Kamervragen voor het Schriftelijk Overleg Klimaat en Energie op 23 april 2020 aangegeven, dat hij bij de vergunninghouder na zal gaan of hij het technisch en bedrijfseconomisch mogelijk acht, met inachtneming van daarvoor benodigde investeringen, dat de levensduur van de kerncentrale op een veilige manier wordt verlengd, en zo ja voor welke periode.

Het gaat in deze fase niet om een compleet overzicht van de benodigde investeringen, maar om een inschatting uwerzijds of gelet op de bij u bekende informatie;

- levensduurverlenging technisch haalbaar zou kunnen zijn
- de daarvoor benodigde investeringen - gelet op de huidige marktinzichten - bedrijfseconomisch verantwoord lijken
- de levensduur met 10 of 20 jaar verlengd zou kunnen worden waarbij de installatie blijft voldoen aan de geldende veiligheidseisen.

Why LTO and Newbuild?

- Security of supply in the absence of sun and wind
- Base load for mains stability and net support
- Continuation
 - NL as an internationally renowned nuclear electricity produce Knowledge centre with 6,000 years of nuclear experience Training institute for nuclear employees
- Experienced organizations for the roll-out of 'operating as a service' (manager and license holder) for new nuclear developments
- 3,800 GWh of CO2-free electricity
 - Approximately 1.5 million tons of CO2 reduction compared to a modern gas-fired power plant *) At a CO2 price of €66 per ton (average 2024 price), €99 million per year lower cost of emission allowances
€99 million means approximately €25 per MWh lower cost compared to a CO2 emitting installation
- Stable and predictable cost price in the period 2034 - 2053



De standaard CO2-emissiefactor voor aardgas in Nederlandse centrales is voor 2025 vastgesteld op **56,2 kg per GJ energie-inhoud**. Voor elektriciteitsproductie met een STEG-centrale (Stoom- en Gascentrale) komt dit neer op een uitstoot van ongeveer 381 g CO2 per kWh (gebaseerd op 53% rendement).

EPZ vision of nuclear energy in the Netherlands after 2033

To achieve the climate objectives, an increasingly large part of our energy needs will need to be met by electricity. Consequently, demand for electricity will soar in the Netherlands in the coming 15 years. EPZ foresees that all the climate-neutral electricity sources will need to be used if we are to meet this increasing demand for electricity.

EPZ is currently the only organisation in the Netherlands which has experience with operating a nuclear power plant in combination with a wind and solar farm. EPZ feels that, under certain conditions, nuclear power will be one of these climate-neutral sources in the future too. To be able to continue using this source, the Netherlands must maintain the knowledge and infrastructure for operating nuclear power plants.

Option 1: Extend operating time

Together with the government, EPZ wants to explore the technical-economic limiting conditions for extending the operating time after 2033 of the current improved Generation I Borssele nuclear power station (approx. 500 MW). Minister of Economic Affairs, Eric Wiebes, has already sent a letter from EPZ on the matter to the House of Representatives.

Option 2: New build

EPZ supports the construction before the mid-thirties of two new Generation III 1,500 MW nuclear power plants in Borssele. The condition is the choice of a proven (and licensed) design for which the licensing and participation procedures can be completed in time. Subsequently, no changes to the design and regulations may be made during construction. Finally, it is essential that any market risk in the business case is covered by the government.

Our journey towards.....

EPZ vision of nuclear energy in the Netherlands after 2033

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For EPZ, there are two obvious options for a combination of the two:

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The condition stated by EPZ is that any market risk in the business case for the Nuclear Power Station in operation at all, the expiry of the operating time from the Nuclear Energy Act.

Ahead of the statutory amendment and the required investigations, it is predicted that the operating time could be extended by 10 to 20 years.

Strategy paper

Extend operating
life time

New Build

Looking out for each other, looking ahead to the future

2021-2025 Coalition agreement

People's Party for Freedom and Democracy
(VVD), Christian Democratic Alliance (CDA),
Democrats '66 (D66) and Christian Union (CU)

15 December 2021

Nuclear paragraph in 2021-2025 Coalition Agreement

Nuclear energy can complement solar, wind and geothermal energy in the energy mix, and can be used to produce hydrogen. It also makes us less dependent on imported gas.

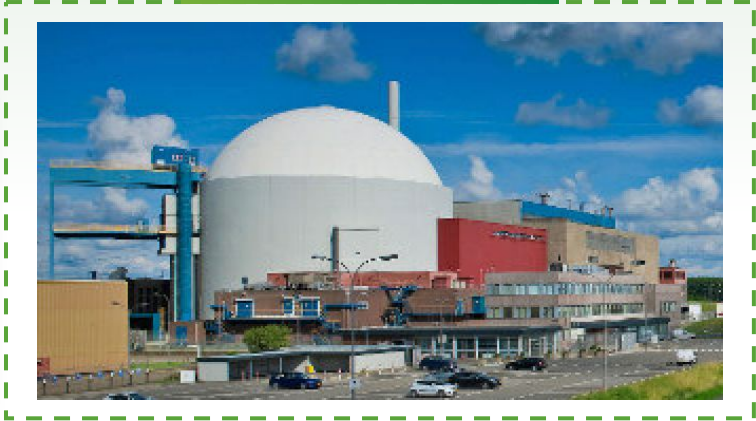
The Borssele nuclear power plant will therefore be kept operational for longer, with all due consideration naturally given to safety. The government will also take the necessary steps for the construction of two new nuclear power plants.

This means that, among other things, we will assist commercial operators in their exploratory studies, support innovation, carry out tender procedures, consider the contribution (financial or otherwise) to be provided by public authorities, and prepare legislation where necessary.

3. Tomorrow

SMR 1973 - 2053

Large > 1.000 MW



Small < 200 MW



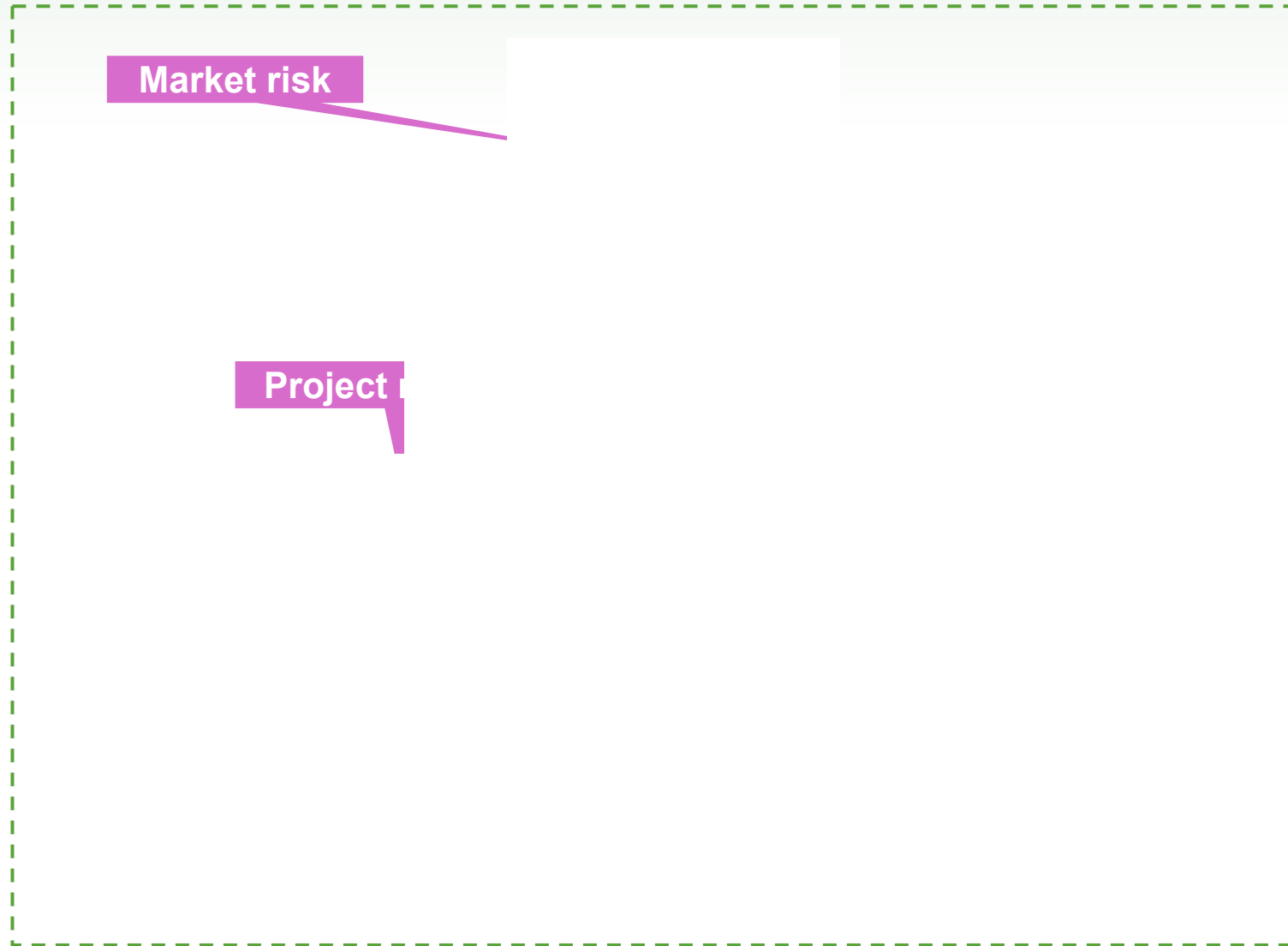
- Extend operating life Borssele 1: LTO-2 from 2033 to 2053
- Operator and license holder of at least 2 units > 1.000 MW
- Operator and license holder of multiple SMRs

Operating as a service

Middle > 300-500 MW



How?

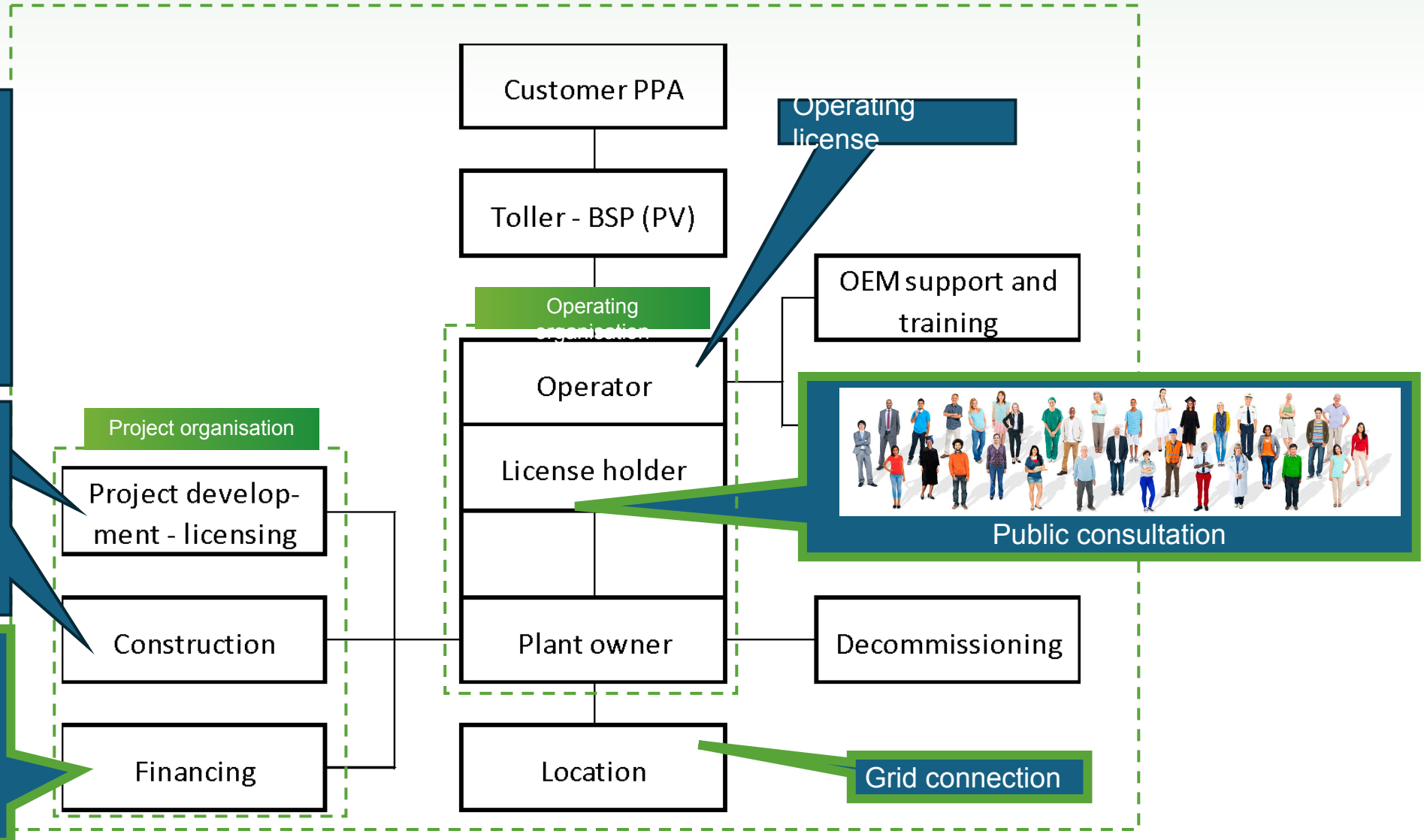


Overview of licenses

- Conventional licenses:
- Environment and Planning Act
 - Nature Conservation Act
 - Flora and fauna exemption
 - Conventional building permit
 - Excavation permit
 - Water permit

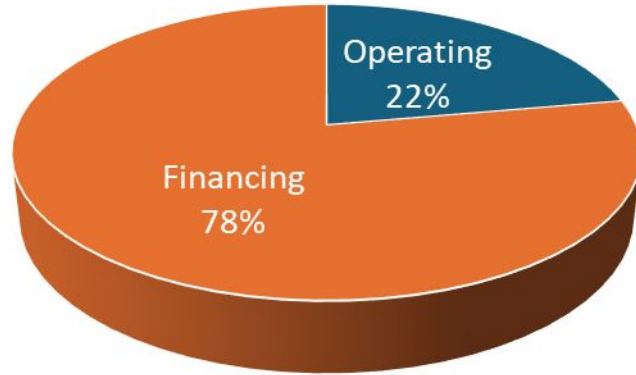
- Nuclear construction license:
- Initial Safety Analysis Report
 - Preliminary SAR
 - Pre operational SAR
 - Final SAR

- Financial?
- Guarantees?
 - Financing?
 - Contract for difference?
 - Other?

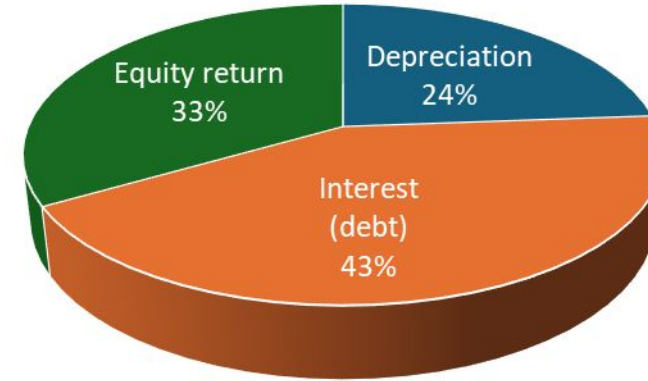


Affordable?

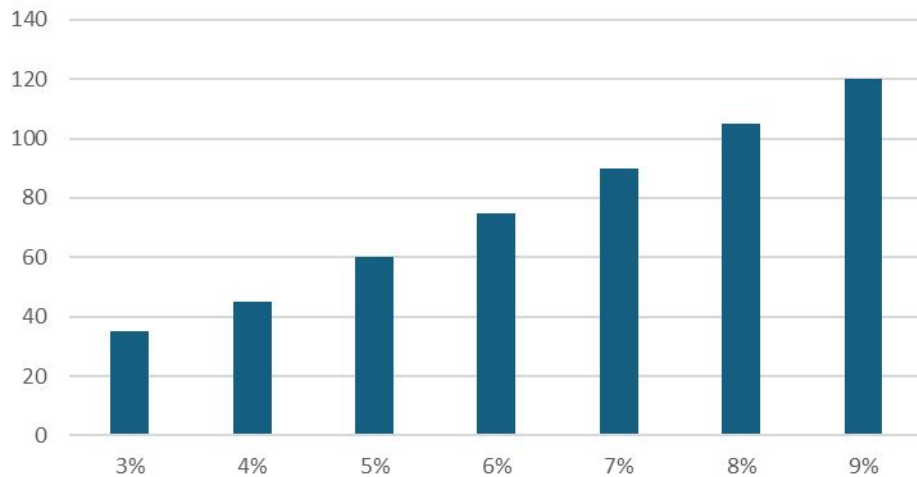
Operating and Financing



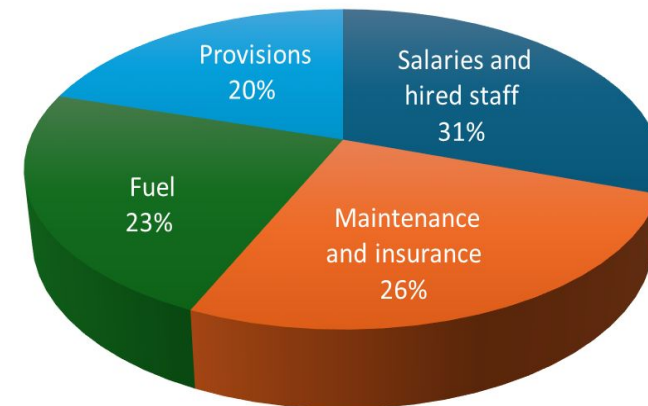
Cost of capital



Financing cost (€/MWh) related to WACC (%)



Operating expenses



Yesterday teaches you; tomorrow gives you a chance

Financieel Dagblad 06-06-26

Kernenergie in de energiemix | x +

→ overkernenergie.nl/kernenergie/kernenergie-in-nederland/kernenergie-in-de-energiemix

🏠 Kernenergie en radioactief afval > Over kernenergie > Kernenergie in Nederland

Kernenergie in de energiemix

Kernenergie kan een belangrijke aanvulling leveren op het energiesysteem in Nederland. Het maakt ons minder afhankelijk van de import van fossiele brandstoffen en levert stabiel en regelbaar vermogen voor als de zon niet schijnt en de wind niet waait.

NPE (Nationaal Plan Energiesysteem)

Het [Nationaal Plan Energiesysteem](#) is een programma van het Ministerie van Economische Zaken en Klimaat dat beschrijft hoe Nederland in 2050 een energiesysteem ontwikkeld dat past bij een klimaatneutrale samenleving. In dit plan staat een langetermijnvisie van het energiesysteem tot 2050. Kernenergie maakt onderdeel uit van deze langetermijnvisie. In dit plan worden heldere doelen en ambities opgeschreven als het gaat om kernenergie in de toekomstige Nederlandse energiemix. **Zo is de bedoeling dat 1,5 – 2,1 Gigawatt (GW) elektriciteit in 2035 uit kernenergie moet komen en 3,5 – 7.0 (GW) van de elektriciteit in 2050 uit kernenergie moet komen.**

Voor na 2035 wordt er rekening gehouden met de bouw van meer dan twee kerncentrales. In het NPE worden verschillende duurzaamheidsscenario's uitgewerkt voor het toekomstige energiesysteem van Nederland.

How?

1. 2 x 1,0-1,5 GW in the north
2. 2 x 1,0-1,5 GW in the south
3. 3 x 0,3-0,5 GW at a utility
4. 3 x 0,3-0,5 GW at industrial sites
5. Multiple Dutch design AMR < 0,1 GW at multiple locations

De onderzoekers concluderen: 'De historische analyse van energieprognoses en -scenario's laat zien dat de toekomstbeelden waarin kernenergie een belangrijke rol speelt, mogelijk nooit werkelijkheid worden.'

Moet Nederland de ambitie om vier kerncentrales te bouwen dan maar opgeven? Dat zou de verkeerde conclusie zijn. Betaalbare en betrouwbare atoomenergie zou Europa zeker kunnen helpen om de klimaatdoelen te halen en onafhankelijker te worden. Maar we moeten het alleen doen op basis van realistische schattingen van kosten, opbrengsten, risico's en bouw tijden. Met optimisme en enthousiasme komen we er niet, zo blijkt uit de geschiedenis.

'...But we should only do it on the basis of realistic estimates of costs, benefits, risks and construction times. Optimism and enthusiasm will not get us there, as history shows..... FD 6-6-26