

Which role can Small Modular Reactors play in Belgium's future energy mix?

Why should Belgium envisage new energy transition options?

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Introduction

Belgium stands at a pivotal point in its **energy transition**. The country faces ambitious climate targets, a challenging geopolitical context, and the closure of most nuclear power plants. Simultaneously, the industry grapples with the most severe economic downturn in a decade, characterized by **falling demand**, **rising production** costs, and **shifting investments** to other regions.

Electricity prices in Belgium rank among the highest globally, impacting competitiveness.

In March 2024, industry leaders from 20 different sectors presented The Antwerp Declaration for a European Industrial Deal. They request to make Europe a globally competitive provider of energy by offering abundant and affordable low-carbon renewable and nuclear energy. In this context, exploring innovative solutions becomes crucial for meeting energy needs sustainably, reliably, and affordably. Small Modular Reactors (SMRs) emerge as a potential solution to address the challenges faced by the energy sector.

On 20th March 2024, KPMG held a round table discussion with stakeholders from the industry and the nuclear sector in order to discuss the potential role of Small Modular Reactors in the next decade in Belgium's energy mix. The discussion was structured in **four sections**:

- status of SMR development in the world;
- potential applications, benefits, and challenges of small modular reactor;
- requirements and needs from the industry;
- financial, policy, and regulatory implications of their deployment in Belgium.

This documents contains a summary of the key messages that were given during the round table.



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01 Why should Belgium envisage new energy transition options?

This section intends to present the key messages that were agreed among the panelists following the round table held on 20 March 2024..

- Belgium faces **important challenges** in its energy transition due to ambitious climate targets, a difficult geopolitical context, and the closure of most of the nuclear power plants.
- Simultaneously, the industry grapples with the most **severe economic downturn** in a decade, characterized by falling demand, rising production costs, and shifting investments to other regions. Affordable energy prices are key to ensuring global competitiveness.
- Industrials are striving for climate neutrality and require significant amounts of **low-carbon energy** and feedstock.
- Industry leaders advocate for a sufficient and affordable supply of low-carbon energy and feedstock, emphasizing the importance of exploring **innovative solutions**.
- Small Modular Reactors (SMRs) emerge as a potential solution to Belgium's energy challenges, offering opportunities for sustainable, reliable, flexible, and affordable energy production.
- SMRs present technical solutions that align with Belgium's energy needs, including electrification, industrial carbon emission reduction, energy diversification, security of supply and lower system costs. They can be used to produce decarbonized electricity, but also heat & hydrogen, and enable large-scale heat storage.
- SMRs offer benefits such as simpler design, modular assembly, and integration into industrial sites, making them viable options for Belgium's energy mix.
- It is technically feasible to have a first SMR pilot project operational in Belgium **by 2035**.
- It is essential for Belgium to position itself on GEN III to be ready for the GEN IV reactors that will be able to recycle the nuclear spent fuel.
- Over the last decade, the SMR industry has largely been in a mode of technology development. The developers of these new technologies must now make the transition from technology development to project delivery.

How to make it happen?

- The **law of 2003** on the nuclear exit needs to be **abolished** to allow for the extension and construction of nuclear power plants.
- Needs of utilities and industries should be identified.
- The **government** needs to define a **clear**, **coherent**, **stable energy strategy**, and define the role of nuclear in the fuel mix. It should implement
- regulatory frameworks to enable the development and deployment of SMRs.
- Collaboration between the energy sector, the industry, and the government is crucial.

Participants

- **Rudy Provoost**, VOKA, Chairman
- Luc Van Opstal, Ineos Inovyn, Site Manager Antwerp
- Mothi Sayeeram, KPMG UK, Partner (Infrastructure Assets and Power)
- Serge Dauby, Belgian Nuclear Forum, Managing Director
- Renaud Crassous, Nuward, CEO
- Grégoire Dallemagne, Luminus, CEO

- Thomas Bohner, John Cockerill, CEO Energy
- David Valenti, Thy-Marcinelle, Director
- Denis Dumont, Tractebel, CEO Belgium, CEO Nuclear
- Peter Claes, Febeliec, Director
- Yves Verschueren, Essenscia, Managing Director

02 Status of SMR development

Renaud Crassous (Nuward)

- The market is very dynamic both on the demand side and on the supply side with over 80 concept Small Modular Reactors (SMRs) and Advanced Modular Reactors (AMRs), or industrial projects in development worldwide.
- There are **two main criteria** to distinguish between SMRs:
 - Technology:
 - Generation III, more mature based on current technologies, LWR (PWR and BWR)
 - Generation IV, which includes:
 - Sodium-cooled reactors (SFR)
 - Lead-cooled reactor (LFR)
 - High-temperature gas-cooled reactors (HTGR)
 - Molten salt reactor (MSR)

- Size
 - Micro reactors (a few MW), with specific business models
 - Medium size (a few tens of MW), more dedicated to the industry
 - Larger size (a few hundreds of MW), more dedicated to electricity

The smaller the size and the younger the generation, the less mature the SMR in the following features:

- technological developments
- licensing
- fuel cycle
- business model for the developers.

Most SMRs are also adapted to co-generation, in particular Generation IV with higher temperatures.

Grégoire Dallemagne (Luminus)

- The big challenge of creating a **net-zero future** and speeding up decarbonization to tackle climate change is **also a big opportunity**.
- The energy mix in Belgium is the following:
 - 50% oil
 - 25% gas
 - less than 20%: electricity (of which 50% nuclear)
- Three levers must be used to tackle the climate change challenge:
 - Reduction of the energy needs

- Energy efficiency
- Electrification: we will need to triple the production and reduce the total system cost
- Concerning electrification, we need to meet 2 conditions
 - Produce enough quantity
 - Foresee a dispatchable capacity

SMRs are complementary to renewables in

these two features and can be a very useful asset that can be integrated into industrial clusters easily and adequately.

Denis Dumont (Tractebel)

Several countries are building their first reactor, in particular in North America. Even more **countries launched a national investment program** in SMRs (for example in Europe, France, UK, Poland, northern countries). The market for **SMR is arriving by 2030-2035** in Europe. US and Canada invest in Gen III. **Gen III is the path to Gen IV**, which is the game-changer. Belgium should start a program now, that includes Gen III reactors, to be ready for Gen IV.

03 Requirements and needs from the industry

Peter Claes (Febeliec)

- Industry must strive to become climate neutral, ideally by 2050. **Electrification** of processes **is a key part** of achieving this goal.
- Industry will require significant amounts of carbon-neutral electricity to power these processes.
- While **renewables** can contribute, they have **drawbacks such as intermittency, high grid connection costs**, and the need for backup solutions.
- To ensure competitively priced and secure electricity availability, a **complementary technology** is essential. In scenarios examined by EnergyVille, the construction of new nuclear facilities was unavoidable for economically viable energy supply in countries like Belgium with limited renewable options.
- SMR's could compensate the closing of the existing nuclear plants, in particular for cogeneration application and with a very low grid connection cost.

Rudy Provoost (VOKA)

To succeed in the **climate neutrality by 2050** there are **key success factors** that can be put forward as the "triple A" challenge:

- **Affordability**: the total system cost must be such that it allows competitiveness of the industry.
- Adequacy: the energy mix must be diversified to be robust and versatile.
- Availability: security of supply and sovereignty are strategic features.

The impact of the SMR breakthrough must be analysed through that prism to see the full equation.

On the need for local energy:

- Belgium imports 90% of its energy.
- 20% of Belgium's energy is electrons, 80% is molecules. By **2050 the electricity need should triple or quadruple.**
- To foster re-industrialization, stability and vertically integrated end-to-end industrial process **a good balance of import and production** should be found.
- The field of possibilities should be enlarged by the politics instead of narrowed (for example, hydrogen production should be encouraged with more sources of energy).
- Carbon neutrality goes along with technological neutrality and should be looked at in a holistic way.

Yves Verschueren (Essenscia)

- There are opportunities for **collaboration between the industry and the different stakeholders** to facilitate the development of SMRs and there are examples abroad, particularly in the chemical industry.
- The condition for the industry to participate in these collaborations is **very clear legal framework** where

investment in new nuclear capacity is being encouraged by the government.

• The **urgency for affordable energy** and a stable framework is high if we want industries to remain in Belgium.

Luc Van Opstal (Ineos Inovyn)

About Ineos Inovyn:

- Antwerp site needs close to a 200MW supply permanently.
- At Ineos Inovyn, the decarbonization ambitions are high and are looked at in a **technology-agnostic** way.

About SMR projects:

- Ineos Inovyn is looking for partnerships:
 - SMR project developers.
 - SMR operators
 - Investors

- Ineos Inovyn is ready to offer:
 - land
 - supplying utilities
 - services, for instance for permitting aspects.
- Ineos Inovyn will not invest its own money into SMR projects but is **ready to sign PPAs**.
- The country's acceptance is of major importance for SMR projects, as well as the possibilities of public funding.

David Valenti (Thy-Marcinelle)

- Thy-Marcinelle produces steel rods for the construction sector, in a **demand-driven market**.
- The process mostly uses electricity (arc furnaces), so is mostly decarbonized as far as direct emissions are concerned. **The price of electricity is paramount**.
- The sector has set stringent decarbonization objectives. The main objectives will come through regulations and there will be a **huge need for decabonized electricity**.
- Industrial companies like Thy-Marcinelle **need** stable volumes of electricity at a stable price and a stable regulatory environment to remain competitive.
- Thy-Marcinelle sees SMR positively and **is willing to consider the role of off-taker in a PPA**. The benefit of PPAs would be to decrease the exposure to spot prices, which will still be driven in the future for a significant number of hours by natural gas.



04 Technical solutions offered by SMRs

Denis Dumont (Tractebel)

- SMRs are designed to be embedded in an **ecosystem**, central to various needs and functions: balancing renewables, producing hydrogen, electricity, high-temperature heat for the industry, low temperature-heat for district heating, e-fuel, and even in the future desalination needs.
- Tractebel has developed a vision in **three pillars** regarding SMRs:
 - Pillar 1: dedicated to a short-term, low-carbon, energy mix - thanks to mature Gen III technologies, such as water-cooled reactors (PWR and BWR).
 - Pillar 2: dedicated to decarbonizing the industry with high-temperature reactors, part of Gen IV.
 - Pillar 3: ensuring long-term decarbonization and allowing and closing the nuclear loop by using reprocessed spent fuel and reducing the historical nuclear spent fuel inventory with fast-neutron reactors, part of Gen IV, as well.

Renaud Crassous (Nuward)

- Compared to large scale-nuclear, SMRs reach the **same safety and competitiveness** objectives, but using a different approach:
 - **simplicity** of design thanks to the lowest power.
 - modularization and in-factory assembly.
 - standardization and series effects.
- SMRs present several advantages:
 - They require a smaller initial investment and have a smoother cash-flow curve.
 - They can integrate with the grid requiring smaller capacities.
 - They have a smaller heat sink need.
 - They are asily integrated to industrial sites or cities due to reduced footprint.
- The target of 2030 for the first SMRs in Europe is dictated by three urgent facts:
 - Climate change
 - Industry needs
 - SMR technology providers' business cases

- The associated realistic dates for Belgium are:
 - Pillar 1: 2030-2035
 - Pillar 2: 2040
 - Pillar 3: 2040-2045

A first pilot SMR in Belgium is technically feasible by 2035. At least ten sites with the right interconnected ecosystem are candidates.

- The main challenges in Europe are to:
 - Simplify the regulatory framework;
 - **Improve delivery** through simplicity and modularity. We need to be able to deliver SMRs like we deliver combined cycles; and
 - Rebuild and maintain a strong local competence and supply chain.

Technical challenges will not be an issue.

- We need to build dozens of SMRs in Europe in the next decade and there will be room for several vendors. Competition is good for two main reasons:
 Price
 - Ability to deliver volume
- To deliver the volume (the number of SMRs) at a competitive price, standardization is key, thus licensing is at the center:
 - For Gen III, the challenge is to align or at least streamline existing regulations and Safety Authorities in various countries.
 - For Gen IV, the challenge is for Safety Authorities to be ready on time, to acquire new knowledge, and to build new rules.

To achieve this:

Nuward, for instance, which is Gen III, involves Safety Authorities from several countries early on in the design, with the Joint Early Review of NUWARD SMR.

Grégoire Dallemagne (Luminus)

• Renewables today represent 20% of the production of **electricity, which needs to triple by 2050** because of electrification.

Thomas Bohner (John Cockerill)

- The **diversity of the energy mix is paramount** and nuclear must be part of it.
- John Cockerill is part of the Belgian historical supply chain of major components and regards SMRs as a **huge economic opportunity for Belgium.**

Yves Verschueren (Essenscia)

• Large industrials, who are often multi-site, international players, are also very interested in standardization, series effects, and fleet effects.

- A **diversified electricity mix**, which would combine nuclear, renewable, and gas fired power plants in Belgium, is required to produce enough electricity at the right time, at the lowest price.
- They want to strongly commit to this business, to **invest and create jobs in Belgium.**



05 How to make it happen in Belgium

Mothi Sayeeram (KPMG)

To make it happen:

- We need to **clearly define** the enduring state (**end state**) and the **transition** to this state to involve all stakeholders of the ecosystem (technology developers, project developers, owners, operators, safety authorities, governments, parliaments, money lenders, off-takers).
- We need to clearly define how and by whom the

Serge Dauby (Belgian Nuclear Forum)

To make it happen:

- We need to **rewrite the nuclear exit law** and create a favorable framework.
- We need alliance and to **speak with one voice**.

Renaud Crassous (Nuward)

To make it happen:

- We need to **foster funding** to fuel the nuclear technology, innovation, and project development on several levels:
 - Privilege European investment.
 - State aids, like France did with France 2030.

major role to play.

development risks are borne. Government has a

- We need clarity on the volume, thus we **need programs** to be put in place
- We need to leverage existing competences and supply chains Belgium has a strong competitive advantage in these areas.

 We must acknowledge that today in Belgium, 87% of the population agrees on the construction of new nuclear infrastructure, according to recent independent study.

• We need to address the regulatory issue.



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Rudy Provoost (VOKA)

To make it happen, we need:

- First, a fully **integrated** industrial, technology, and energy **strategy**.
- Second, an adequate **regulatory and legal framework** providing clarity on three dimensions:
 - Funding.
 - Permitting and licensing process.
 - **Rewrite the nuclear exit law** and even have a more ambitious lifetime perspective for the plants.

Yves Verschueren (Essenscia)

We need to **change the perception** and communicate about the successes.

- Third, an ecosystem approach:
 - By leveraging our existing nuclear assets and competences.
 - By launching a nuclear innovation programme possibly in the framework of the Energy Transition Fund, ideally at European level.
 - By putting forward partnership, alliance, and mutual reward principles.



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