



F- SMR

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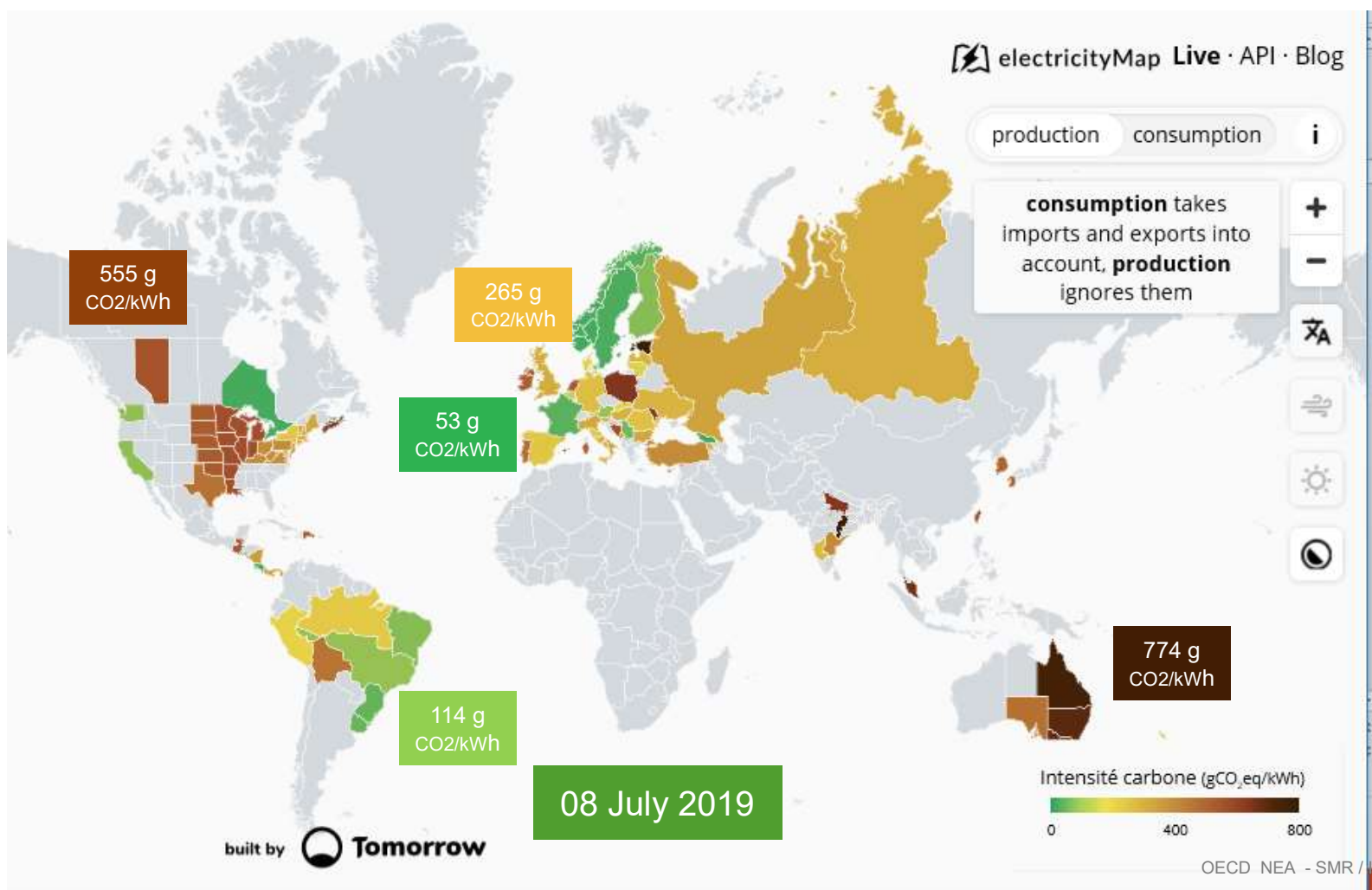
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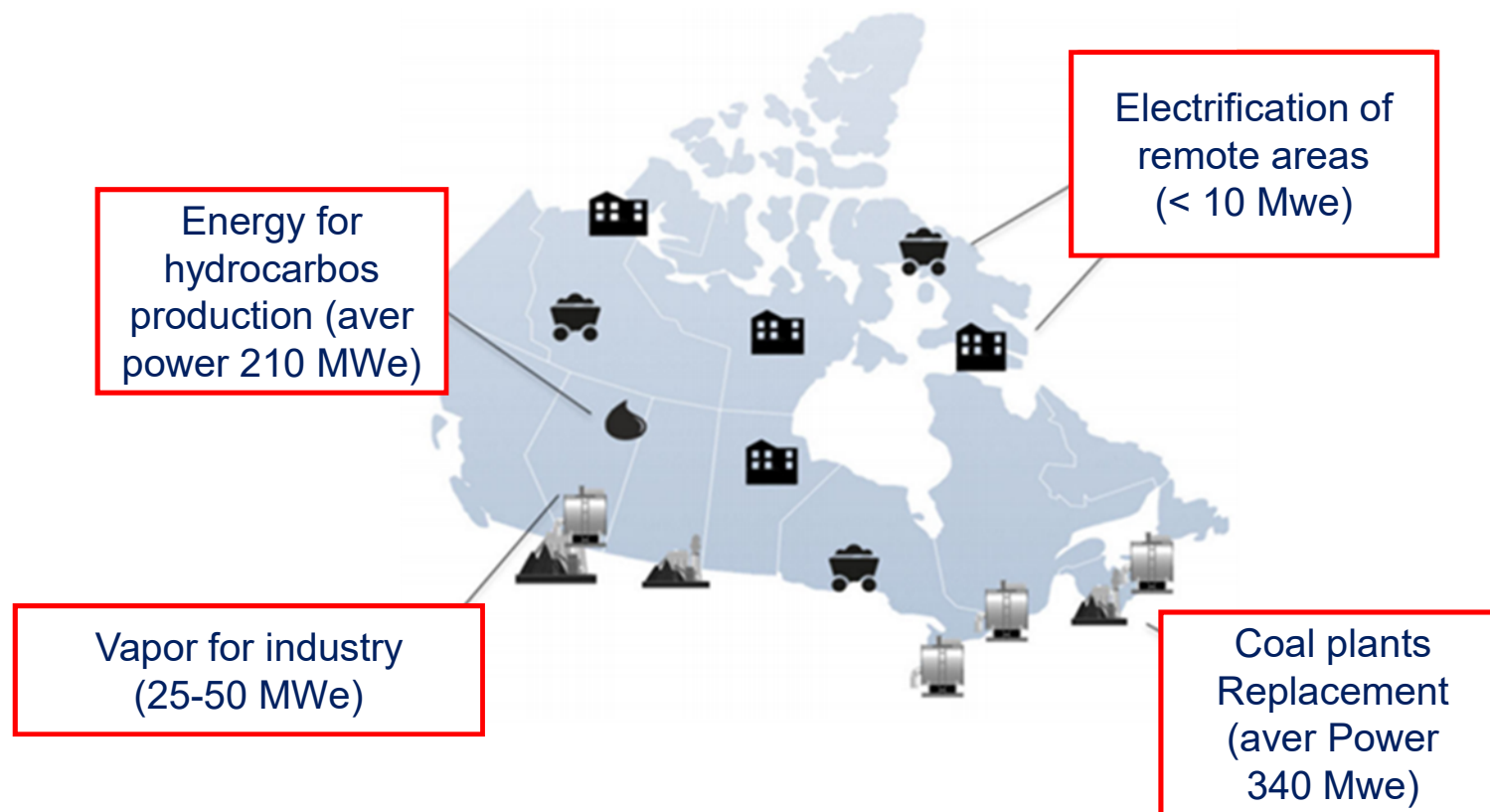
1. Why developing SMR
2. SMR features
3. Challenges
4. A dedicated team

LET'S ASSUME A TARGET OF 150 gCO₂/kWh TO TURN ALL BROWN INTO GREEN

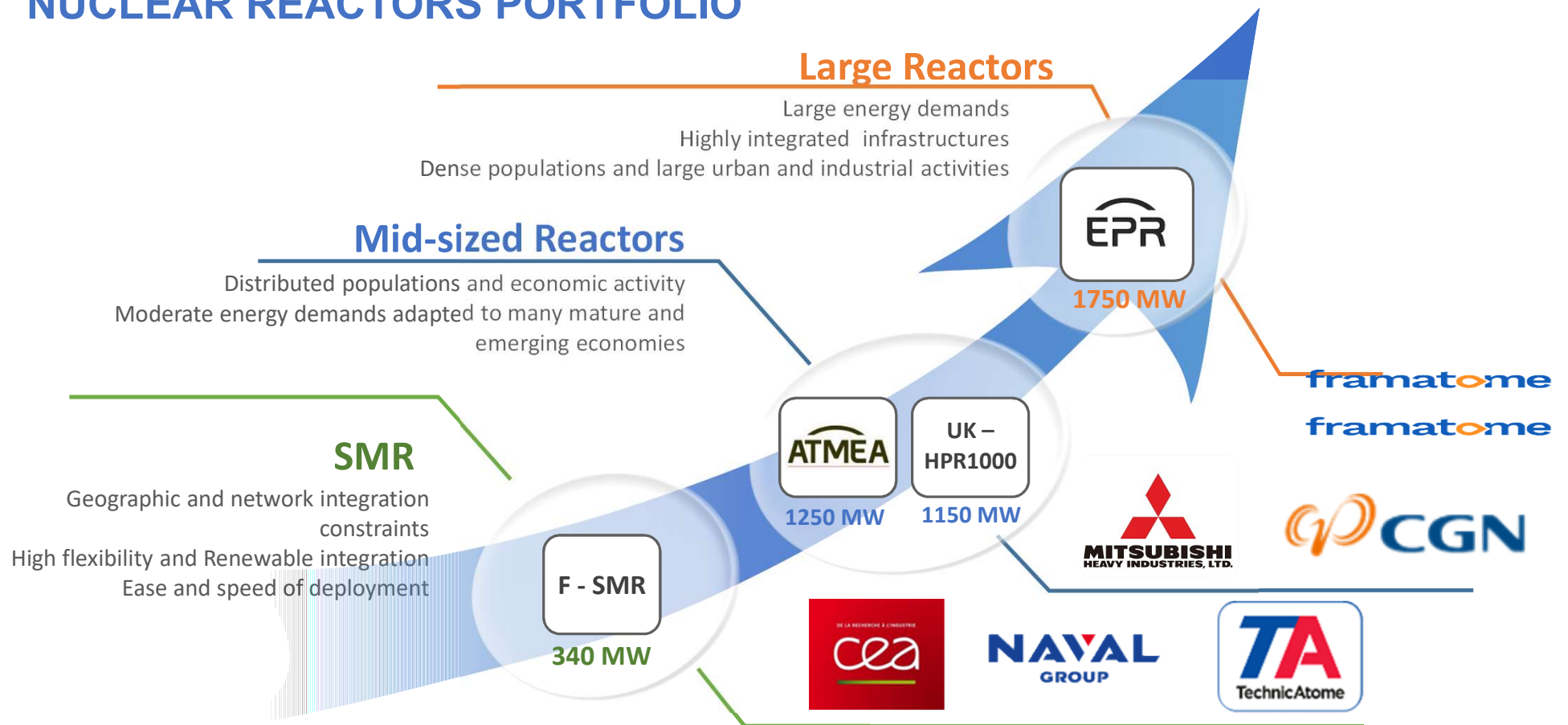


NUCLEAR
ENERGY
REQUIRED
TOGETHER WITH
RENEWABLES

ALBERTA PROVINCE IN CANADA : AN EXCELLENT BUSINESS CASE TO DECREASE FROM 550 TO 150 gCO₂/kWh – SMR BUSINESS CASE



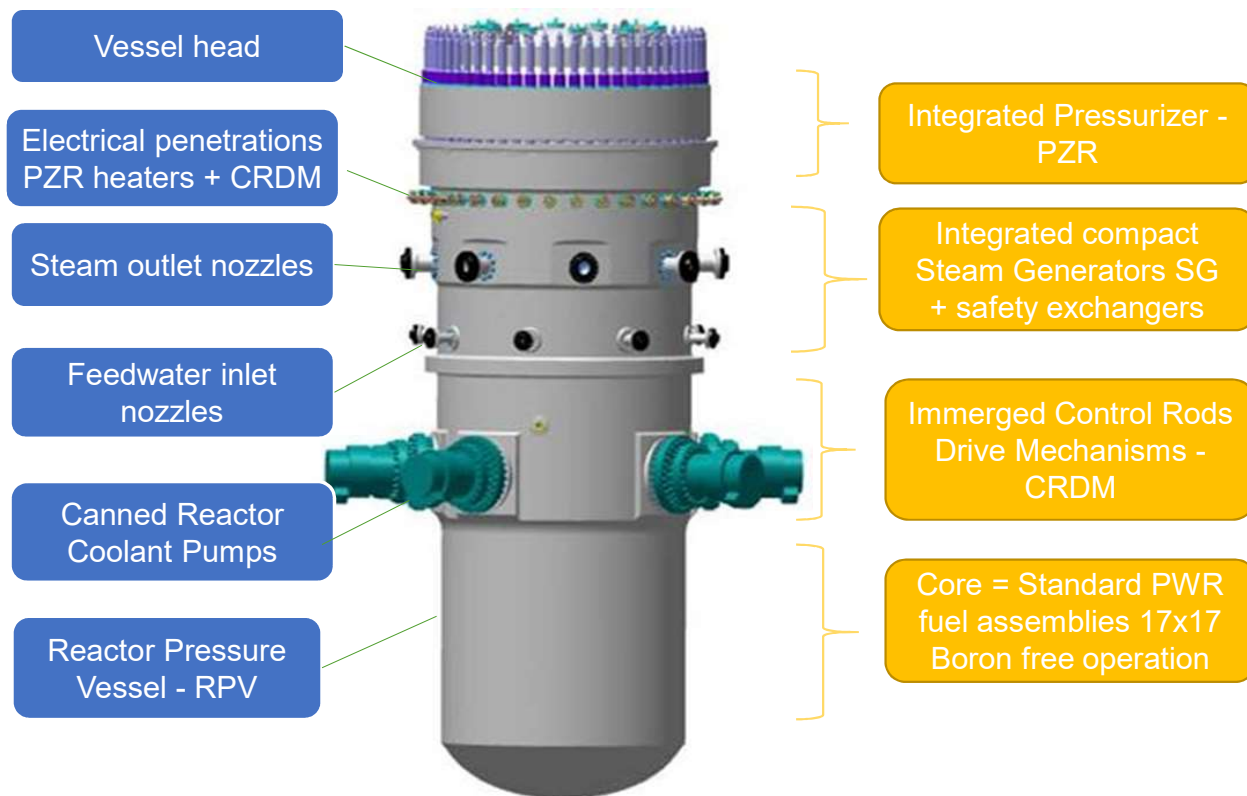
DEVELOPING SMR TO FILL THE GAP OF LOWER POWER RANGE IN THE NUCLEAR REACTORS PORTFOLIO





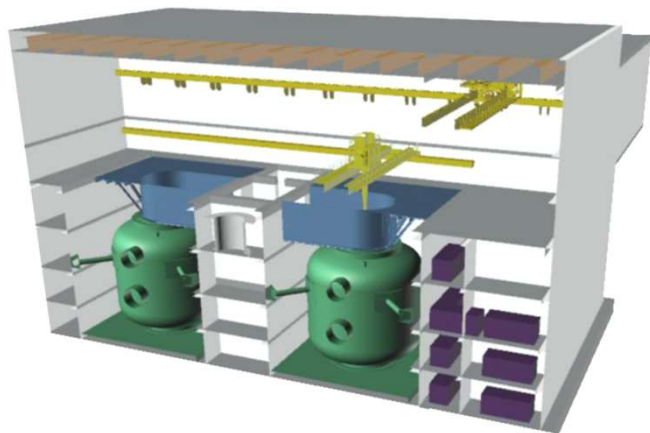
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SMR : 2 X 170MWE - INTEGRATED REACTOR ARCHITECTURE



F-SMR REACTOR MAIN DESIGN CHARACTERISTICS

Thermal Power	2 x 540 MWth
Electrical power output	2 x 170 MWe
Thermal Efficiency	> 37 %
Plant design availability	> 90%
Nb. of loops	integrated
Operation cycle length	Up to 24 months
Design service life	60 years
Instrumentation & Control	Fully Digital



Integrated reactor located in a metallic containment shell (H 16m),
Containment immersed in a water basin

- 1 CONVENTIONAL ISLAND**
allowing a 37% thermal efficiency
- 2 NUCLEAR ISLAND**
semi-buried

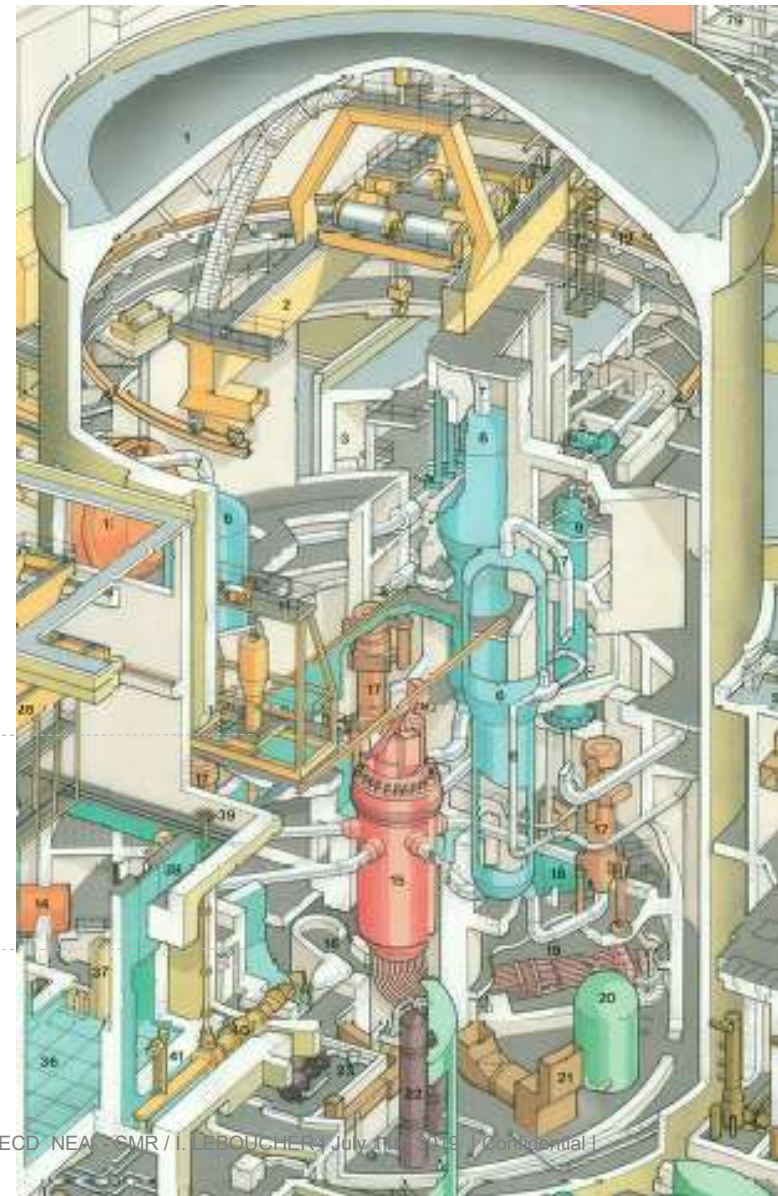
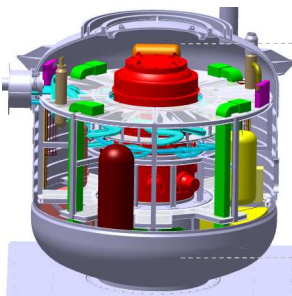


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ADRESSING COMPETITIVENESS CHALLENGE : COMPACITY

PWR 900 Containment :
 Φ_{int} 37 m – h: 58m

SMR reactor:
 Φ_{int} 15m - h:16m



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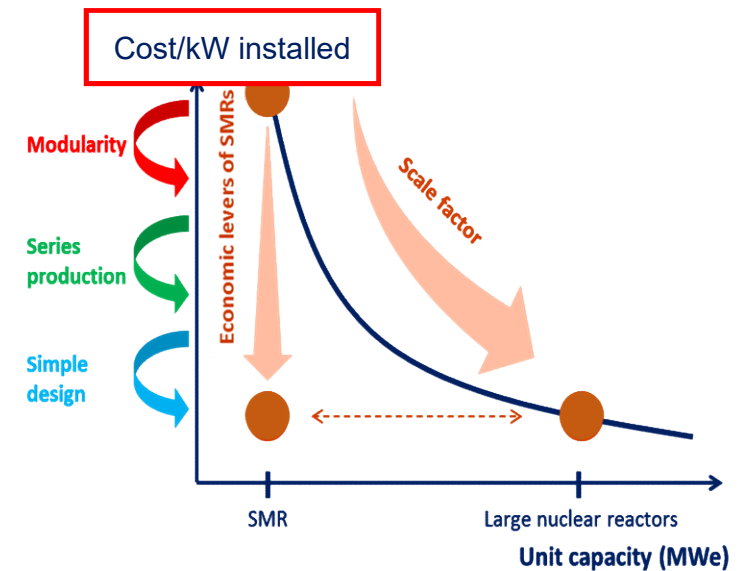
COMPACTY ALOWS MODULARITY

■ Economic levers vs Scale Effect

- **Modular design** and manufacturing (construction cost decrease, shortened construction duration)
- **Series effect** (In series production of components, standardisation...)
 - **Simplification of design** (architecture, components, regular civil structure, easy and quick to build)

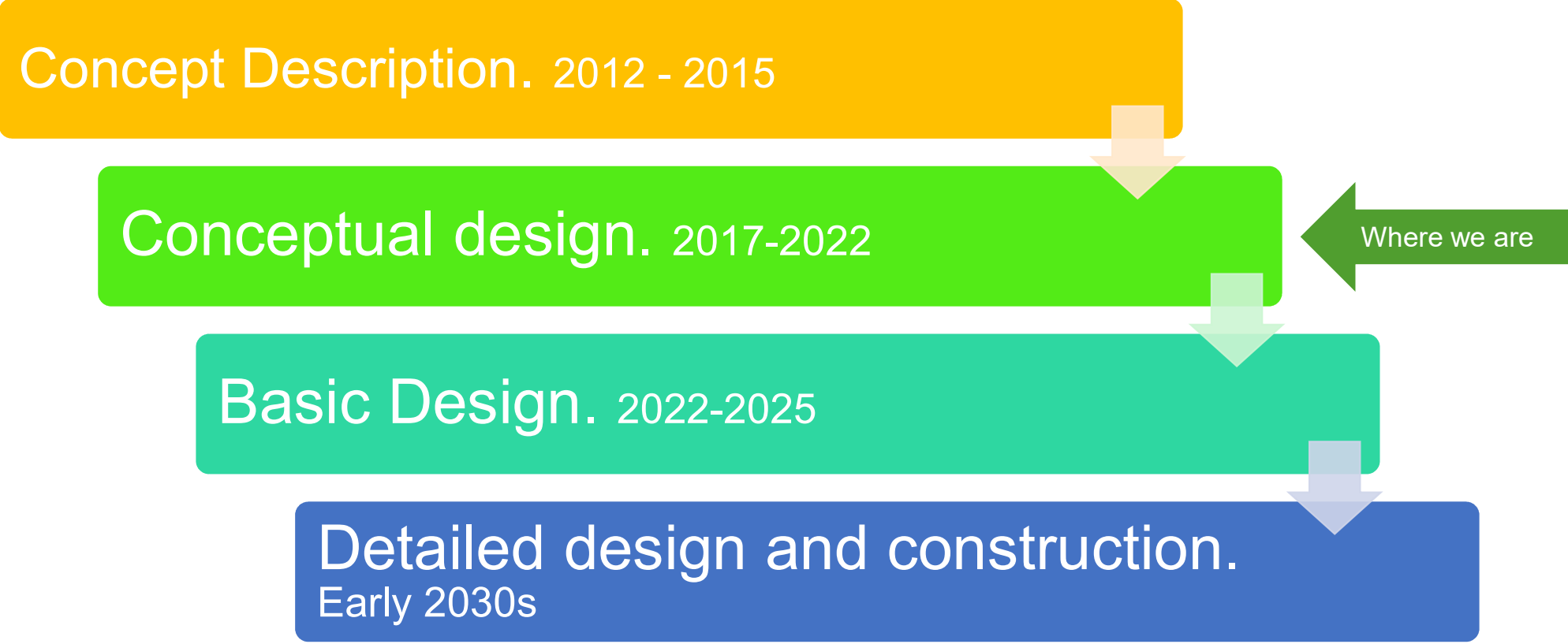
■ Standardization and international deployment

- Standard design, licensable in several countries
- Safety case based on extensive use of passive systems
- Qualification of modular fabrication and construction
- International initiatives for adaptation and convergence of national nuclear regulations for SMRs (IAEA, WENRA, ...)
- Opportunities for international cooperation for development and operation.



TIME TO MARKET : DEVELOPMENT PHASES FOR F-SMR

Concept Description. 2012 - 2015



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graph TD; A[Concept Description. 2012 - 2015] --> B[Conceptual design. 2017-2022]; B --> C[Basic Design. 2022-2025]; C --> D[Detailed design and construction. Early 2030s];
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Conceptual design. 2017-2022

Where we are

Basic Design. 2022-2025

Detailed design and construction.
Early 2030s

DEVELOPING A SMR FOR A FUTURE OPERATOR : 19 ISSUES MUST BE ADDRESSED AT EACH PHASE OF THE PROGRAMME



Source: Milestones in the development of a national infrastructure for nuclear power – IAEA 2015



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COMBINING SKILLS OF PARTNERS FOR SMR DEVELOPMENT

Atomic Energy and Alternative Energies Commission (CEA)

- French public research institution in low-carbon energies (nuclear and renewable energies), defense and global security, information and health technologies
- A key player in research and innovation with 16,000 scientists, engineers, and support staff in 10 research centers

- Core designer
- Involved in the reactor design
- Thermohydraulic codes, expertise and test facilities



EDF Group

- Designs, builds and operates nuclear plants in France and abroad
- Architect Engineer for new build projects
- The World's largest nuclear operator
- Produces around 22% of the European Union's electricity, primarily from nuclear power

- NPP Architect Engineer
- Safety demonstration
- Operation & maintenance



COMBINING SKILLS OF PARTNERS FOR SMR DEVELOPMENT



An European leader in naval defence and a major player in marine renewable energies:

- designs, builds and supports submarines and surface ships including manufacturing of nuclear reactor equipment.
- supplies services to shipyards and naval bases
- offers a wide range of marine renewable energy solutions.



- **Steam conversion system**
- **Modular concept**
- **Steel containment and nuclear equipment**



- Specialized in the design, construction, operation and maintenance of compact nuclear reactors
- For more than 45 years, offering nuclear engineering expertise on reactors, fuel and related facilities
- Proposes solutions and products that meet the highest safety and availability standards
- About 1,600 people and operates for naval propulsion, research and energy.



- **SMR reactor designer**
- **New technologies developer**



KEY TAKE AWAY

1. France believes SMR can be competitive provided
 - It targets a baseload power segment today dominated by high carbon capacities
 - It targets significant market shares raised by the need to tackle CO2 emissions : shift from coal plants to SMRs
 - Compacity, modularity and series effect allow manufacturing of equipment and project delivery cost effectiveness
 - Product development must be thought as a nuclear power plant for future operators
2. Partnership is key to bring the best skills in the product development



THANK YOU FOR YOUR ATTENTION