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Unique nuclear heat: Blue Capsule's singular approach to design simplification and integration in small modular reactors

With nuclear energy poised to play a more prominent role in global decarbonisation efforts, small modular reactor (SMR) innovators are seizing the opportunity that reduced use of fossil fuels implies. Currently, 10 per cent of global greenhouse gas emissions are a direct consequence of fossil fuel combustion to produce heat for industrial processes, so companies like Blue Capsule, a spin-off from France's CEA, are proposing a reactor design that maximises the production of industrial-grade heat (air at up to 700℃) for new markets; namely onsite co-location at hard-to-abate industries such as ammonia and soda ash production. For this to work, the modularity of a Blue Capsule is allied with a simplified cross-over of two mature technologies: the TRISO-based prismatic fuel from high-temperature reactors (HTRs), and the coolant of sodium-cooled fast neutron reactors. This paper explores the resulting reactor concept, identifying both the simplification and integration facets of this SMR as a unique proposition to Europe's SMR ecosystem. The paper finds that Blue Capsule's design can address well-known difficulties associated with nuclear technologies: (i) safety, regulatory and physical issues (i.e. cold source availability); (ii) the competitiveness of nuclear heat compared with fossil fuel heat, and; (iii) low maximum temperatures for nuclear reactors available on the western market.

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