
Terrestrial Energy
Carbon-Free Energy for Global Industry
2022 Hybrid Molten Salt Reactor (MSR) Workshop - 11th October 2022
TERRESTRIAL ENERGY

IMSR innovation

Key innovation is the sealed and replaceable Integral Molten Salt Reactor (IMSR) “Core-unit”

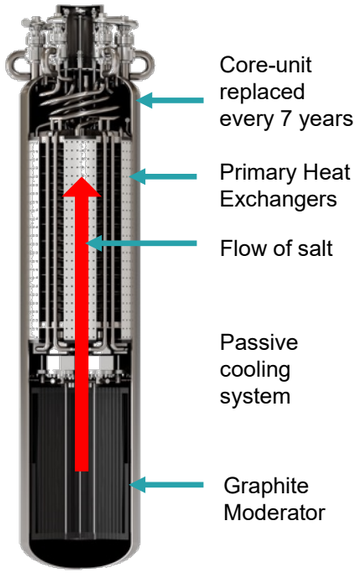
All primary reactor components are contained in the sealed “Core-unit” 1, transportable via rail, truck or sea 2.

One operating Core-unit in each reactor building 3 form part of the dual-reactor nuclear facility 4.

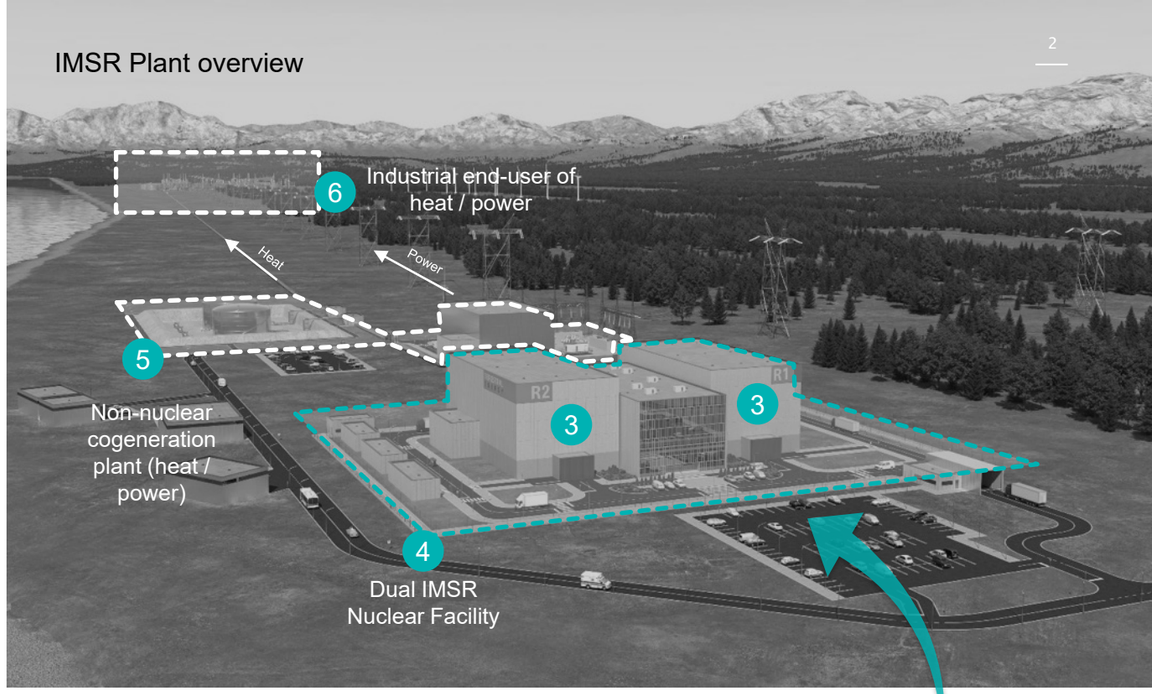
The nuclear facility 4 is separated from the non-nuclear thermal / electrical facilities 5, customized to end-user 6 needs

2 Illustration of truck transport of IMSR Core-unit

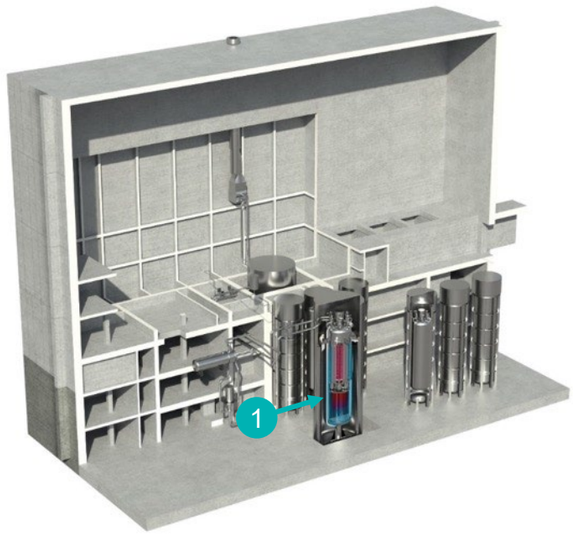
1 IMSR Core-unit cut-away



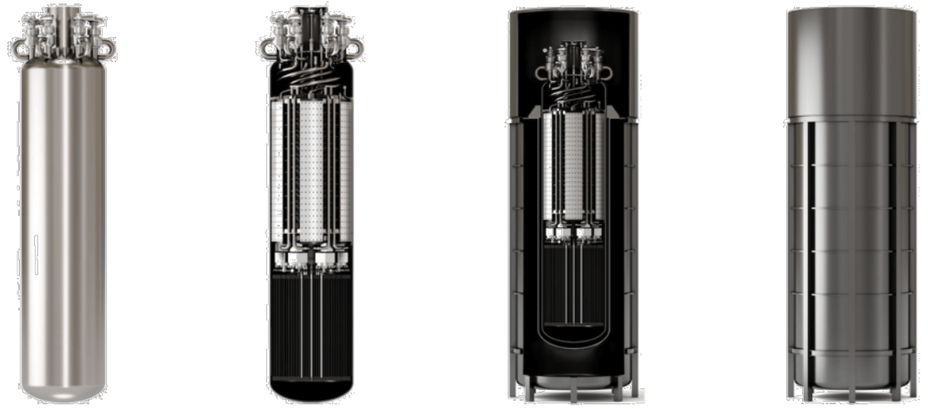
IMSR Plant overview



3 Cut-away reactor building, one of two in the IMSR plant



1 IMSR Core-unit cut-away including guard vessel and containment



IMSR Core-unit in outline and cross-section

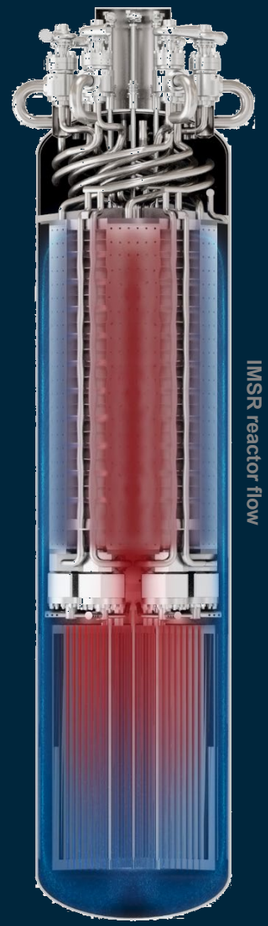
IMSR Core-unit with guard vessel and containment structure in outline and cross-section

Note: For illustration purposes only. Source: Company

IMSR Plant vs conventional nuclear plant

Using molten salt reactor technology for carbon-free high-temperature heat supply, the IMSR Plant has transformative performance benefits compared to a conventional nuclear plant

IMSR key technology advantage is the use of a molten salt coolant using standard assay, low enriched uranium (<5%). This is a superior coolant and foundational to the compelling, commercial, economic and use-case advantages of the IMSR Plant



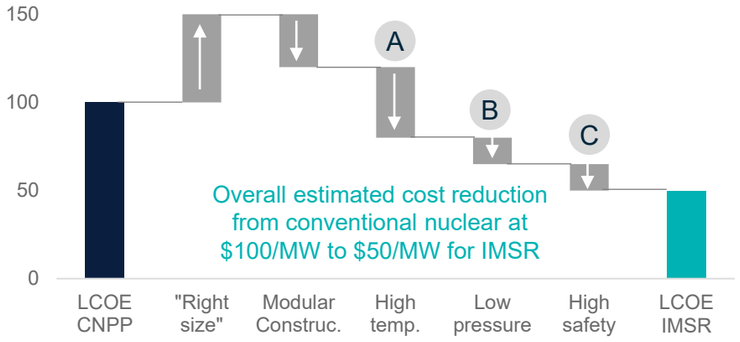
	IMSR Plant	Conventional Nuclear Plant
Coolant	Molten Salt	Water
Temperature of Thermal Supply	585°C	290°C
Net Thermal Efficiency of Electricity Generation[1]	44%	~30%
Pressure	Low: 1 bar (atmospheric)	High: 70-160 bar
Application	Industrial heat & electric power	Electric power only
Modularity	Standardised, factory prod.	Bespoke on 1-off basis
Load-following	Yes	None – baseload only
Construction Time	Under 4 Years	Over ~10 Years
Unit Capital Cost	~$1-2 Bn	Over $10 Bn
Capacity (net)	822 MWth / 390 MWe	1,000 MWe
Levelized Cost of Heat ($/MMBTU)	Under 6	N/A
Levelized Cost of Electricity ($/MWh)	Under 50	Over 100
Fuel Cycle	7 years	18 months
Waste	33% less fission product waste per kWh by mass	

Note: 1. Thermal efficiency for a 1GWe Conventional Nuclear unit is 33%, but it's ~30% for a unit of similar size to IMSR
Source: Company

IMSR technology and design choices

High thermal stability of molten salt enables safe high-temperature and low-pressure operation. This is essential for higher generating efficiency, higher power plant revenue and lower CAPEX

The levelized cost of electricity (LCOE) vs conventional nuclear (“CNPP”) (USD / MWe)



Note: Smaller reactor size drives up cost per MW. This is offset by modular factory production, lower cost, higher temperature and safer operations. Illustrative.

Molten salt coolant

Superior reactor coolant
- High thermal stability
- High neutron stability
- High heat capacity

A High temperature = Higher revenues

Operates at high temperature for 50% greater thermal efficiency vis-a-vis conventional nuclear (water-cooled nuclear technology)
- Generates 50% more kWh(e)s for 50% more revenues
- More capital efficient and profitable operation

B Low pressure = Lower CAPEX

No high-pressure nuclear systems, structures, or components
- Plant simplification
- Smaller plant
- Modular design for shorter build-time
- More financeable

C Safe Operation

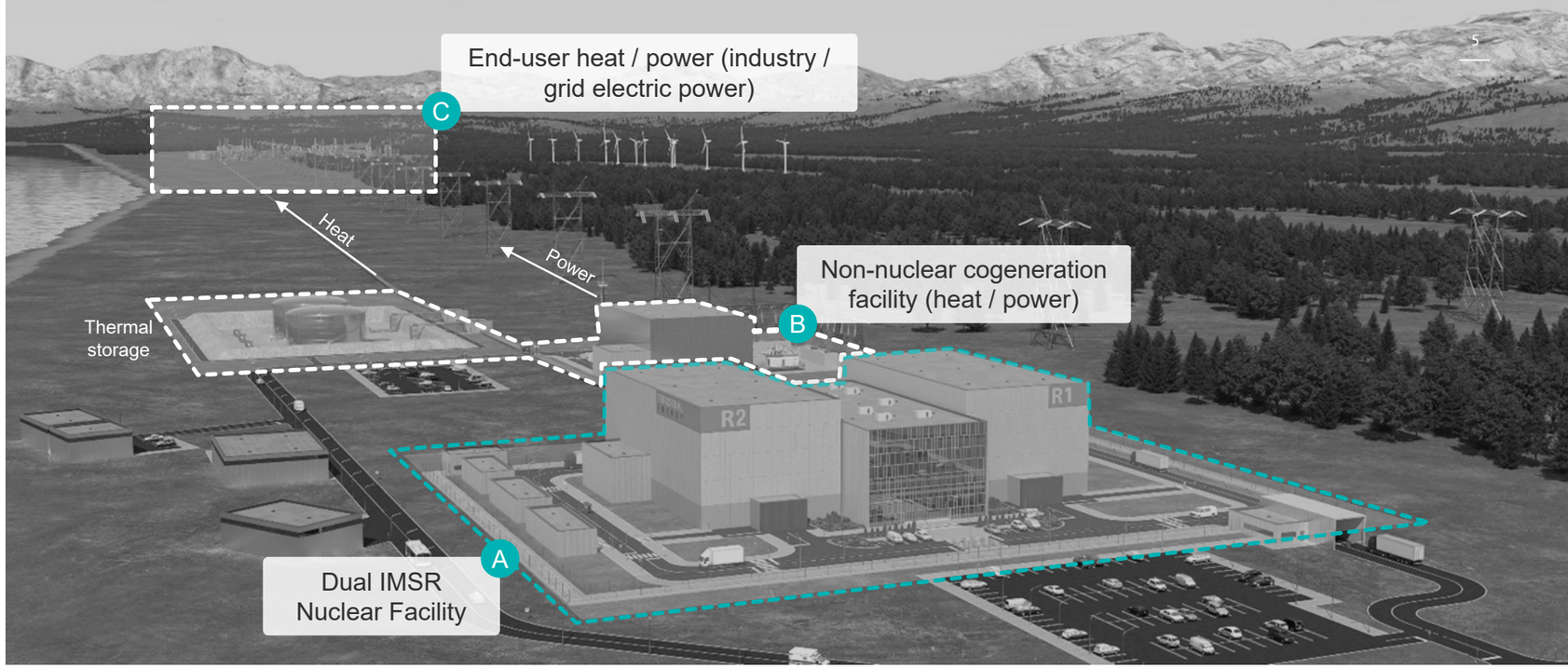
Use of a molten salt coolant and fuel delivers high inherent safety
- Negative temperature coefficient of reactivity for inherent power control and load-following
- Fluid convection supports passive dissipation of fuel heat
- Supports social license

Uniquely flexible to deliver the heat and power needed

Separation of nuclear systems from thermal and electrical systems gives the flexibility that is essential to serve industries' many cogeneration needs

This separation of nuclear systems enables a standardized reactor design for regulatory efficiency while meeting the site- and use-specific needs of the industrial user with a customized Thermal and Electric Facility

The Nuclear Facility and Thermal and Electrical Facility are constructed in parallel

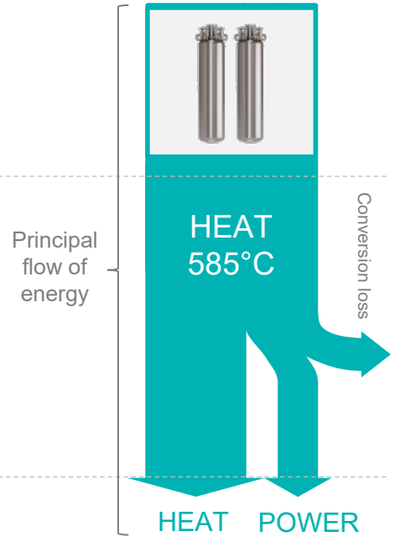


A Standardized dual IMSR Nuclear Facility

- Subject to nuclear regulation
- Standardized, simplifying design and saving costs
- 884 MW (gross) thermal energy production for 585°C supply

B Customized non-nuclear Thermal and Electrical facility

- Converts 884 MW (gross) thermal energy from two IMSRs to 585°C 822 MW (net) thermal or 390 MW (net) electric power for commercial supply – or any heat/electric power mix in between
- Can be commissioned and operating prior to Nuclear Facility (initially natural gas and electric grid powered)
- Can include molten-salt thermal energy storage and buffering to enhance an already strong load-following performance for commercial advantage



C Industrial cogeneration off-takers

- Chemical and petrochemical plant
- Hydrogen / ammonia / fertilizer plant
- Other industrials requiring clean heat & power

Municipal off-takers

- Electric grid
- Desalination

822 MWth (thermal) 〈〈〈 585°C 〉〉〉 390 MWe (electrical)

Note: Example is for a dual reactor core IMSR Plant. Scaling up is possible.

Regulatory engagement

Terrestrial Energy's regulatory program started early with the commencement of the CNSC's Vendor Design Review (VDR) process in 2016

Canada

CNSC VDR scope covers all aspects of IMSR Plant construction, operation and decommissioning

Terrestrial Energy successfully completed VDR Phase I in 2017, an industry first

VDR Phase II and final phase is on schedule to be completed in 2022 and expected to be an industry first for a high-temperature reactor

USA

Terrestrial Energy commenced USNRC regulatory engagement in 2017

Strategy is a 10CFR Part 52 Standard Design Approval of the IMSR Core-unit

This is a prerequisite to 10CFR Part 50 Construction Permit Application or to a 10CFR Part 52 COLA

International

IMSR selected for a joint and cross-border inter-agency (CNSC/USNRC) collaborative regulatory review of IMSR technology

Terrestrial Energy commenced engagement with the International Atomic Energy Agency (IAEA) in 2020

Review of IMSR security and safeguards underway with Canadian Nuclear Laboratories supported by Canadian grant funding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