1 December 2024

#06

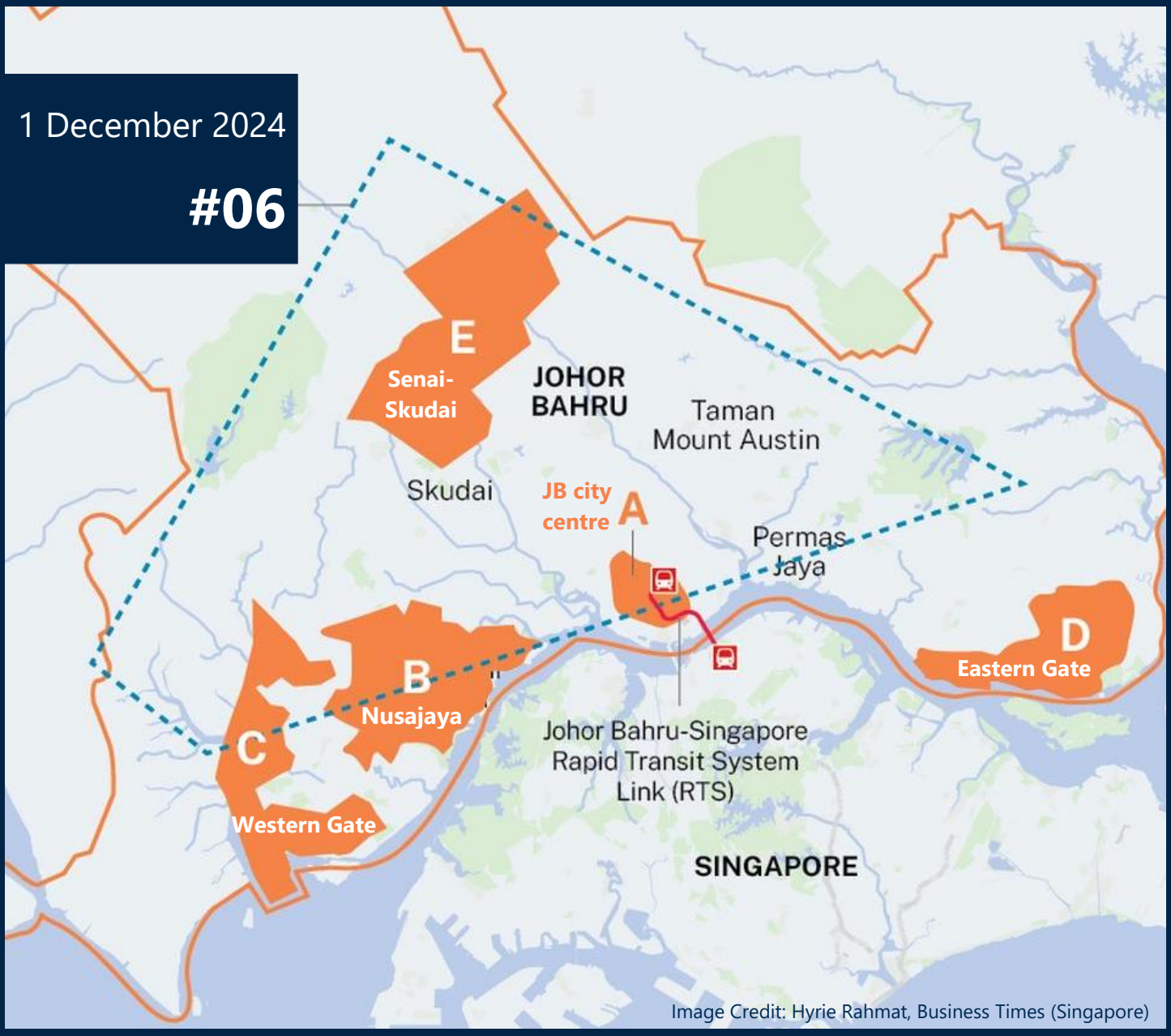


Image Credit: Hyrie Rahmat, Business Times (Singapore)

Powering Progress: A Strategic Nuclear Energy Partnership Between Singapore and Malaysia

By Victor Nian, Paul Murphy, Caitlin Murphy

Centre for Strategic
Energy and Resources

POLICY BRIEF

Centre for Strategic Energy and Resources

Highlights

1. Embed nuclear energy as part of industrialisation and digitalisation expansion plans
2. Include nuclear energy cooperation as part of the Malaysia-Singapore Interconnector capacity usage.
3. Build a strategic joint ownership arrangement to help facilitate nuclear project development via the Johor-Singapore Special Economic Zone
4. Draw from existing cross-border nuclear collaborations, such as Krško Nuclear Power Plant (Slovenia-Croatia)
5. Include nuclear energy in the scope of Energy Exchange Malaysia (ENEGEM) and in the ASEAN taxonomy

Summary

In an era marked by escalating energy demands and the urgent need for sustainable solutions, a potential collaboration between Singapore and Malaysia on a nuclear power plant emerges as a pivotal strategy. As both nations navigate their distinct challenges—Singapore grappling with severe land constraints yet boasting substantial financial resources, and Malaysia possessing ample land but facing funding limitations—this suggested partnership presents a unique opportunity. The Johor Bahru State of Malaysia, positioned strategically across from Singapore, could become a critical hub for this initiative, catering to the projected energy needs of both countries while addressing their decarbonisation goals.

What's the issue?

Singapore's energy demand has been steadily increasing in the past decade. According to the Energy Market Authority of Singapore, between 2021 and 2022, electricity consumption increased by 2.6 per cent. The Commerce and Services related sector saw 6.8 per cent growth in 2022 compared to 2021, with the Information and Communications sector having the largest percentage growth of 20.4 percent, arguably driven by the increase in data centres, as the "Smart Nation" initiative continues its trajectory.

Currently, data centres consume approximately 1.4 gigawatts (GW) of electricity, with expectations of a dramatic rise as the nation seeks to solidify its position as a regional tech powerhouse.[1] The Singapore Government's initiative to increase energy allocation for these data centres by 35 per cent underscores the urgency of expanding energy capacity.

However, Singapore's heavy reliance on imported natural gas—accounting for 95 per cent of its electricity generation—presents a significant vulnerability.[2] This dependency not

[1] Ong, Sing Yee. "Singapore to Free Up More Power for Data Centre Expansions." *Bloomberg* (Singapore), May 30, 2024.
[2] Koh, Ann. "Singapore's Energy Dilemma a Small-Nation Warning." *Bloomberg* (Singapore), February 11, 2022.

only exposes the city-state to price fluctuations but also hampers its ability to meet ambitious climate targets, including a commitment to achieve net-zero emissions by 2050.[3] According to the Green Plan 2030,[4] the government's aim to increase solar installed capacity to 2 GW-peak by 2030 (translating to around 4 per cent of its energy mix) illustrates the formidable constraints posed by its geographic limitations relative to generation sources that lack the energy density and energy intensity of nuclear energy.

Conversely, Malaysia faces its own set of challenges and opportunities in the energy arena. With a rapidly growing industrial base, particularly in sectors like steel and cement (*which are not only energy intensive but also could benefit from an export perspective if they are viewed as sustainably produced, but which also require clean, baseload sources of energy*), the demand for reliable/baseload, clean energy is paramount. The Johor region is becoming a focal point for foreign investment and industrial growth.[5] Companies such as TikTok and Microsoft are already establishing data centres in the region, further amplifying the demand for electricity.

As Malaysia positions itself for sustainable economic expansion, its energy strategy must align with decarbonization goals. The integration of clean energy sources is critical not only for meeting domestic demands but also for enhancing competitiveness in the global market. By leveraging nuclear energy to power industrial operations, Malaysia can make substantial progress toward its sustainability objectives, creating a model for low-carbon industrial practices in the region.

Why is this important?

Both Singapore and Malaysia are at a crossroads in their respective energy transitions, facing significant challenges in moving away from fossil fuel dependency. Singapore's current energy mix remains predominantly reliant on natural gas, with efforts to diversify—including a carbon tax and increased solar capacity—yielding limited results thus far.[6] This reliance on fossil fuels poses a substantial barrier to achieving the country's environmental ambitions. Singapore plans to import up to 4 GW of low-carbon electricity by 2035 (approximately 30 per cent of its total electricity supply).[7] Malaysia, too, grapples with a historical dependence on fossil fuels, though recent initiatives have focused on integrating renewable energy sources. The interplay between economic growth and environmental sustainability will necessitate innovative strategies that leverage existing resources effectively and which support industrialised economies.

The World Nuclear Association puts both Singapore and Malaysia in the conversation for future nuclear power programmes.[8]

[3] Energy 2050 Committee. 2022. *Charting the Energy Transition to 2050: Energy 2050 Committee Report*. Singapore: Energy Market Authority of Singapore.
[4] Government of Singapore. "Singapore Green Plan 2030." Ministry of Environment and Sustainability, February 10, 2021. https://www.greenplan.gov.sg/.
[5] Ruehl, Mercedes. "From Palm Oil to Data: Malaysia Builds AI Hub on Singapore's Doorstep." *Financial Times* (Johor Bahru, Malaysia), July 18, 2024.
[6] Bernard, Steven. "Singapore Fails to Keep Pace with Wealthy Peers on Carbon Emissions." *Financial Times* (Singapore), March 12, 2021.
[7] Seah, Sandra, Terence Goh, Genessa Chew, Hong Yun Chang, Wei En Hoong, and Graeme Hutchison .2024. *Malaysia-to-Singapore Electricity Imports*. Singapore: Bird & Bird LLP.
[8] "Emerging Nuclear Energy Countries." World Nuclear Association, April 26, 2024. https://world-nuclear.org/information-library/country-profiles/others/emerging-nuclear-energy-countries.

Malaysia hosts a research reactor,[9] and Singapore continues to evaluate the potential for nuclear energy.[3] In 2023, Malaysia also adopted a National Nuclear Technology Policy 2030, with the stated purpose to enable Malaysia to optimise the peaceful use of nuclear technology for socio-economic development.[10] With expected surge in electricity demand, especially from industries, data centres, and electric vehicles, Deputy Prime Minister Datuk Seri Fadillah Yusof commented that nuclear power is "among the clean energy sources that could meet…" such rising energy demand with stable and economically competitive supply.[11]

On 31 July 2024, Singapore and the United States signed a civil nuclear cooperation agreement, known as a "123 Agreement", marking a significant step in its exploration of nuclear energy as a means to decarbonise its power sector.[12] This agreement allows Singapore to access vital information and technological expertise while fostering cooperation in peaceful nuclear applications. As stated by Foreign Affairs Minister Vivian Balakrishnan, it supports Singapore's efforts to evaluate advanced nuclear technologies, including Small Modular Reactors (SMRs). However, the country has made it clear that it has not yet decided to deploy nuclear energy, emphasising that any decision will depend on thorough assessments of safety, reliability, and sustainability.

The 123 Agreement also positions Singapore to collaborate with other nations using U.S. nuclear technology, enhancing its capabilities in nuclear science and safety. This development aligns with Singapore's broader strategy to achieve net-zero emissions by 2050, as it explores all potential options for decarbonization. If Malaysia and Singapore were to consider a joint nuclear power initiative in Johor Bahru, this partnership could significantly contribute to regional energy security and sustainability while adhering to international safety and non-proliferation standards.

Singapore and Malaysia have been pushing for a mutually beneficial Johor-Singapore Special Economic Zone (JS-SEZ) since January 2024, with both countries finalising the deal in late 2024. The goal is to strengthen economic connectivity and promote cross-border trade, investment and people mobility between Singapore and Malaysia. The possibility of having high-speed rail connection between Singapore and Kuala Lumpur means both convenience and rising demand for clean energy.

With the rise in digitalisation, artificial intelligence and hence the need for data centres and their supporting information and communication infrastructure, as well as the upcoming high-speed rail connector, the JS-SEZ is poised to become a thriving future industrial, commercial, and arguably residential region attracting talent and businesses, potentially experiencing a steady rise in the demand for 24/7 carbon free energy. Johor officials have said the SEZ could create as many as 100,000 new jobs in the state and bolster the Malaysian economy by about $26 billion per year by 2030.[13] With Malaysia planning to exhaust the remaining power transmission capacity of the Malaysia-

[9] "Asia's Nuclear Energy Growth." World Nuclear Association, November 4, 2024. https://world-nuclear.org/information-library/country-profiles/others/asias-nuclear-energy-growth.
[10] Ministry of Science, Technology and Innovation. 2023. *National Nuclear Technology Policy (DTNN) 2030*. Kuala Lumpur: Government of Malaysia.
[11] Hamzah, Siti R. "Fadillah Assures Careful Review Before Nuclear Power Commitment." *BERNAMA* (Kuala Lumpur, Malaysia), November 11, 2024. https://bernama.com/en/business/news.php?id=2361776.
[12] "Joint Statement on the Signing of the United States - Singapore 123 Agreement 31 July 2024." Ministry of Foreign Affairs of Singapore. July 31, 2024. https://www.mfa.gov.sg/Newsroom/Press-Statements-Transcripts-and-Photos/2024/07/20240731--123A-Joint-Agreement.
[13] Bosley, Catherine, and Ram Anand. "Singapore-Johor Economy Deal Signing Gets Pushed to November." *Bloomberg* (Singapore), August 29, 2024.

Singapore Interconnector to supply clean energy to Singapore[14], it is an opportune moment to consider nuclear energy in the clean energy mix.

What should the policymakers do?

1. Foster a strategic and economic partnership riding on the prospective development of JS-SEZ

Demand for 24/7 clean energy driven by the potential rise in businesses moving towards the JS-SEZ could potentially transform the JS-SEZ to become the first geopolitically appropriate location for hosting the ASEAN (acronym for Association of South-East Asian Nations) region's nuclear power plant with shared interests, benefits and risks, all of which have been properly examined and executed previously with Malaysia-Singapore gas and water export dating back to the 1960s. Now with plans to utilise all of the 1 GW Malaysia-Singapore interconnector, Johor stands out as an optimal site for a nuclear power plant, given its strategic location across the causeway – already attracting heavy energy consumers, such as heavy industries and data centres. The need for affordable, reliable, and secure 24/7 carbon free energy provides a basis for the establishment of a nuclear facility that could provide a stable, low-carbon electricity that is essential for both nations, facilitating energy security while supporting industrial growth.

In addition, the bilateral discussion should also include cooperation in nuclear-relevant supply chain and forward-looking joint infrastructure development to create additional opportunities for energy intensive high-value add industrial clusters, such as semiconductors, pharmaceuticals, and high-performance computing services for running mega-models and artificial intelligence. Such cooperation can also extend to nuclear industry focused capacity building in human resources and research and development, and collaborative programmes through universities and national research centres.

2. Identify the appropriate roles of key stakeholders when planning for newbuild nuclear infrastructure

Cross-border nuclear projects require the agreement and participation of all key stakeholders from Malaysia and Singapore. The International Atomic Energy Agency has established guidelines for international collaboration in nuclear power project development, emphasising the importance of clearly defined roles and responsibilities. Under this framework, Malaysia could serve as the host country, responsible for the construction, operation, and regulation of the nuclear facility, while Singapore could engage as an investor and off-taker, thus ensuring economic viability. Ultimately, the host country would bear more of the responsibility for the project, from a nuclear infrastructure perspective, but that would not preclude cooperation between the two countries during the development phase (pre-Final Investment Decision) of the project.

[14] Aziz, Adam. "Green Energy Sale to Singapore Capped at 300MW, Single Buyer to Operate Energy Exchange — EC." *The Edge* (Kuala Lumpur, Malaysia), April 17, 2024.

3. Embed decarbonisation efforts alongside opportunities for industrial growth

The rapid expansion of data centres in Johor accentuates the urgency for a reliable and clean energy source. Despite Singapore's lifting of the three-year moratorium on new data centres, the high and rising electricity price compounded by a highly uncertain future market landscape has resulted in many companies redirecting investments to Johor, where land and energy resources are more accessible.[15] At the same time, both Malaysia and Singapore are looking to decarbonise the "hard-to-abate" sectors, such as the oil and gas, cement, and steel industries. With Malaysia's plan to phase out coal by 2044, there is a need for both countries to identify and agree on the mutual benefits of having a joint nuclear power facility to effectively meet the rising energy demand for data centres while also reducing the carbon footprint of legacy industries. By deploying nuclear reactors, the JS-SEZ can make substantial progress toward its sustainability objectives, creating a model for low-carbon industrial practices for ASEAN and a justification for including nuclear energy in the ASEAN taxonomy.

4. Learn from the international cross-border nuclear energy cooperation

The concept of cross-border energy cooperation has been well established, such as the European Union's interconnected electricity grid, renewable energy sales from North Africa into Europe, and the interconnectivity between the United States and Canada. The ASEAN Power Grid, started in the 1990s as a key pillar of the ASEAN Plan of Action on Energy Cooperation (APAEC), is positioned to be the artery for green energy across ASEAN. These models can serve as reference points for the production, transmission, and distribution of power across the two jurisdictions – Malaysia and Singapore – allowing both markets to bolster the commercial case for a nuclear reactor. Furthermore, the idea of multi-national ownership of a nuclear power project is not unprecedented. The Krško Nuclear Power Plant is jointly owned by Slovenia (host) and Croatia, and the two countries have benefited economically from this shared infrastructure arrangement.

Determining the appropriate ownership structure will be critical for the success of this venture. Singapore's involvement could range from being a co-owner and developer to a purely financial investor and off-taker, which would provide essential economic certainty for the project. This flexibility allows both countries to optimise their contributions—Malaysia providing land and operational oversight, while Singapore contributes financial resources and technological expertise. In addition, the recent establishment of the Energy Exchange Malaysia (ENEGEM) with the aim to create a competitive platform for aggregating and trading green energy from Malaysian independent power producers for export also represents an enabling option for nuclear energy to be included in the scope of trading.

5. Adopt a forward-looking principle but pay attention to the importance of addressing legacy infrastructure related issues

The Centre for Strategic Energy and Resources pointed out the need for the energy transition to focus not only where the world is transitioning "to", but "from", which

[15] Lim, Janice. "Singapore Unlikely to Draw Large-scale Data Centre Investments despite Added Capacity: Report." *The Straits Times* (Singapore), June 4, 2024.

is a fossil or thermal dominated economy with dispatchable electricity familiar to power grid operators. Nuclear energy is a thermal energy source that can generate 24/7 dispatchable clean energy electricity. As Malaysia and Singapore confront their respective energy challenges, the proposed collaboration on a nuclear power plant in Johor represents a forward-looking solution. By combining Malaysia's land resources with Singapore's financial and technological capabilities, both nations can create a robust energy infrastructure that meets their growing demands while advancing decarbonisation goals. At the same time, both countries can work in synergy to develop a future cost competitive digitalisation hub alongside other clean industrial hubs, such as those for hydrogen, ammonia, methanol, and green steel for collectively expanding international export of green fuels and products.

In the last three years, energy security has become a key theme in national planning. Together with achieving net zero goals, nuclear energy can be the cornerstone of a Clean Growth Strategy, emphasising the importance of clean, baseload energy for industrialised economies. The key is to combine sustainability and environmental stewardship with the recognition that energy security and economic security overlap and reinforce each other. The joint development of long-term nuclear related infrastructure project would enable the opportunity for Singapore and Malaysia to embark upon a new era of collaboration while setting an example on strategic infrastructure cooperation for ASEAN.

Biography

Dr Victor Nian is a Founding Co-Chairman of the Centre for Strategic Energy and Resources. His expertise is in energy, sustainability and net-zero policy and strategies. He is one of the go-to-persons in nuclear energy and the hydrogen economy in Southeast Asia. Dr Nian holds a PhD in Mechanical Engineering and a BEng (Hons) in Electrical Engineering with a Minor in Management of Technology, all from the National University of Singapore.

Victor Nian

Founding Co-Chairman of Centre for Strategic Energy and Resources

Paul Murphy is the Managing Director of Murphy Energy & Infrastructure Consulting, LLC (MEIC), Greensabre Consulting Ltd, and Cross River Infrastructure Partners, and an affiliate of Nuclear Economics Consulting Group.

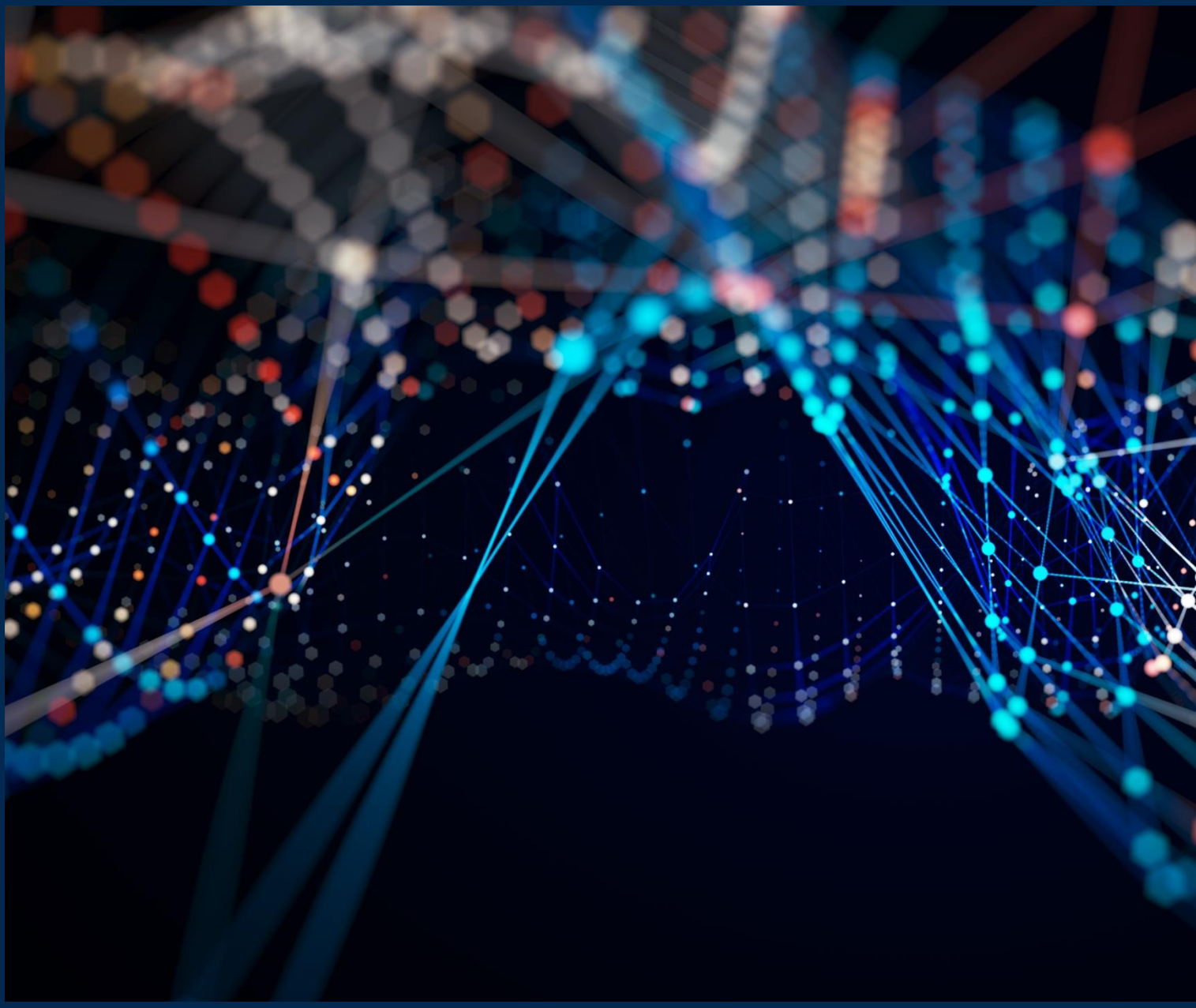
Paul Murphy

Managing Director of Murphy Energy & Infrastructure Consulting

Caitlin Murphy is a research assistant for MEIC and is Sophomore at Boston College in the International Studies Programme with a concentration in Political Economy & Development Studies. She is also pursuing a double major in Psychology.

Caitlin Murphy

Research Assistant of Murphy Energy & Infrastructure Consulting



Contact info
CSER Secretariat
Email: secretariat@cser.energy
Website: www.cser.energy
Address: 50 Bukit Batok Street 23, #08-15,
Singapore 659578

Centre for Strategic Energy and Resources

An independent think-and-do tank