Exercise 1

Problem Statements that could be chosen for RVB

general: How can the Rijksvastgoedbedrijf improve and balance its energy supply and demand across its real-estate portfolio, while remaining robust under different energy-transition (net-congestion) scenarios, without increasing pressure on the already congested public electricity grid?

operational: supply–demand & flexibility: How can the Rijksvastgoedbedrijf strategically deploy local generation, storage, and flexible demand at its sites to achieve a reliable and sustainable energy system, without causing additional congestion on surrounding electricity networks?

spatial: How can the Rijksvastgoedbedrijf use spatial and technical data to identify where and how to invest in grid-aware energy solutions (generation, storage, direct connections), in order to contribute to a resilient energy system while avoiding negative impacts on constrained grid areas?

Exercise 2

General Background/Research

The central framing of your case is that Rijksvastgoedbedrijf (RVB) holds significant real-estate and energy footprints across government buildings and land parcels, and that it must navigate an evolving Dutch electricity infrastructure where **grid capacity is increasingly scarce**. In many locations the network is approaching or has reached congestion: either because more generation (solar & wind) is being connected, demand is rising (electrification of heat, mobility), or both. As the case points out, this means RVB cannot always secure adequate connection capacity for its own loads and cannot easily leverage its own sites for new production or storage without impacting or being blocked by the grid. Your task is to map out the decision-space for RVB—what levers are available, what constraints apply, what trade-offs occur, and how RVB can position itself.

From the broader literature one sees three broad categories of decisions available: **(1) invest in more grid capacity / net reinforcement**, **(2) invest in flexibility (demand shifting, storage, smart control)**, and **(3) smart siting & direct linkages** (for example localized generation-to-load, bypassing congested network segments). These correspond quite neatly with the levers identified in the case. For each of those decision categories there are constraints, costs, benefits and strategic interactions.

Decision category 1: Network reinforcement / “netverzwaring”

The base approach is to increase transport capacity: upgrade lines, add transformers/substations, strengthen network segments. The literature shows this remains the most direct but also the most costly and slow path. For instance, the Dutch energy sector association states that netcongestion costs the economy **billions**, and that net reinforcement is “on average 10 to 50 times cheaper than mitigative measures” in certain contexts—though still expensive overall. A PBL fact-sheet explains that when peak flows exceed capacity (either in high voltage or distribution), the only remedy is either reinforcement or redistribution of

From that we derive the decision of whether to rely on network upgrades, and if so, where: e.g. focus on bottleneck nodes, high-demand clusters (RVB major buildings), priority areas. But key constraints: long lead-times (years), regulatory/permit challenges (land use, environment), high capex, and risk of stranded-assets if demand patterns change. The case forces RVB to consider: do I wait for the network to catch up (and lose generation or connection capacity meanwhile) or do I anticipate and act?

Decision category 2: Flexibility & smart demand/supply management

Given that reinforcement is expensive and slow, the second axis is to **reduce or shift peak flows** through smart means: demand-side management, storage (batteries), time-shifting loads, local generation timed to demand, smart EV charging or heat pumps. Research by TNO shows that many neighbourhoods in the Netherlands, if left unmanaged, will experience low-voltage grid congestion by 2030–2035, but that the use of smart devices can avert many congested hours. Another RVO report deals with flexibility for companies and institutions: it emphasises the need for data, contract models, incentives, and standardised processes.For RVB this means decisions about: Should I deploy on-site storage? Should I shift building loads (HVAC, EV charging) to avoid peaks? Should I integrate micro-grid / cluster solutions with neighbours? What business/contract models and organisational changes will support that? What are the cost/benefit trade-offs (capex + operation vs avoided congestion cost or avoided waiting list for connection)?
Flexibility is more nimble than reinforcement, but it has its own limits: may reduce peaks but not eliminate persistent high flows; there may be comfort/usage trade-offs; regulatory and contractual frameworks may not fully support valorisation of flexibility. An academic study of EV charging flexibility in the Dutch context shows there is significant potential—but aggregating and commercialising it remains challenging

Decision category 3: Smart siting, generation-to-load links & network bypass

A third axis is to **rethink spatial deployment**: locating generation, storage or major loads in places where network capacity is still underutilised; creating direct private lines from generation to load (thus bypassing constrained network paths); clustering loads and generation to optimise local flows; choosing sites with favourable grid capacity. This is very relevant to RVB, because RVB controls land and buildings and so can influence siting decisions. For example, RVB might decide: locate a solar park on a plot that is adjacent to my high-demand campus, enabling a local loop that avoids congested feeder lines; or cluster several RVB buildings in a micro-grid sharing storage and generation assets. The case mentions “cable-to-neighbour” and “direct lines” as options.

In the regulatory sphere, such direct connections and private networks raise issues: network access rules, internal vs external consumption, metering, which authority is responsible. The legal research on netcongestion in NL emphasises that regulatory frameworks are still evolving. Hence RVB’s decisions here: Which of my properties are best suited for direct generation-to-load? What are the contractual/technical/regulatory barriers? Should I partner with private developers or tenants? How to optimise the cluster configuration, storage sizing and load profiles?

Summary of decision-space

- In summary: RVB’s decision-space can be visualised as a 3-dimensional space defined by: **(i) scale/timing of investment (now vs later)**, **(ii) type of intervention (reinforcement vs flexibility vs siting/linkage)**, and **(iii) risk/uncertainty scenario (various future demand/generation paths)**. Within that space, RVB must select a portfolio of actions across its asset base: which sites to develop for generation/storage/flexibility; which to hold or defer; how to engage with network capacity planning; how to structure contracts/organisation; how to optimise across cost, risk, and time.
- By mapping each site with its load/generation potential, grid-connection status & planned reinforcement, RVB can produce a ranking of where investments will give the highest marginal benefit (in terms of avoided waiting, increased generation, reduced congestion risk) and lowest cost/risk. Overlaying future scenarios provides robustness: for example, sites that perform well in both high-electrification and moderate-growth scenarios.
- The literature reinforces that timely flexibility interventions can deliver value and relieve congestion, but they do not replace reinforcement entirely. Moreover, the societal cost of congestion is non-trivial (thousands of €/MWh) which supports proactive action. Regulatory and organisational readiness is a key enabler but sometimes a bottleneck.

https://www.energie-nederland.nl/netcongestie-kost-miljarden-netverzwaring-is-de-oplossing/

https://arxiv.org/abs/2403.13367

https://www.rvo.nl/sites/default/files/2025-03/Rapportage%20Flexibilisering%20Bedrijven%20en%20Instellingen%20Definitief%202.pdf

https://www.tno.nl/en/newsroom/2024/11/preventing-grid-congestion-smart-devices

Rijksvastgoedbedrijf en netcongestie

- **Rijksvastgoedbedrijf & CE Delft (2023) – Rijksvastgoedbedrijf en netcongestie: uitdagingen en oplossingen**
  Link: https://www.rijksvastgoedbedrijf.nl/documenten/2023/09/29/rijksvastgoedbedrijf-en-netcongestie-uitdagingen-en-oplossingen
- **RVB – Toolbox Netcongestie (PDF)**
  Link: https://www.rijksvastgoedbedrijf.nl/site/binaries/site-content/collections/documents/2025/04/15/netcongestie/Toolbox_Netcongestie_Extern_TG_PDFA-2.pdf
- **RVB nieuws – "Door netcongestie dreigt afsluiting gebouwen"**
  Link: https://www.rijksvastgoedbedrijf.nl/actueel/nieuws/2025/04/16/door-netcongestie-dreigt-afsluiting-gebouwen
- **RVB nieuws – "Netcongestie: 'Piekbelasting is het grootste probleem'"**
  Link: https://www.rijksvastgoedbedrijf.nl/actueel/nieuws/2024/02/19/netcongestie-piekbelasting-is-het-grootste-probleem

2. Beleidskader NL-energiesysteem & netcongestie

- **Nationaal Plan Energiesysteem – hoofdrapport (NPE)**
  Link: https://www.rijksoverheid.nl/documenten/rapporten/2023/12/01/nationaal-plan-energiesysteem
- **Nationaal plan energiesysteem – PDF (officiële versie)**
  Link: https://zoek.officielebekendmakingen.nl/blg-1120658.pdf
- **Landelijk Actieprogramma Netcongestie – hoofdrapport (LAN)**
  Link: https://open.overheid.nl/documenten/ronl-4a4a6f1bcb4f30278f4205aeb085c3208f62e8a6/pdf
- **LAN – voortgangsrapportage maart 2025 (RVO)**
  Link: https://kennisdelen.rvo.nl/file/download/50e2d60c-dfa2-4aab-b580-9ed1c801d45b/lan-voortgangsrapportage-maart2025.pdf
- **Actualisatie voortgang Landelijk Actieprogramma Netcongestie (2025)**
  Link: https://www.rijksoverheid.nl/documenten/rapporten/2025/09/30/actualisatie-van-de-voortgang
- **Programma Energiehoofdstructuur – beleidsrapport (PEH)**
  Link: https://www.rijksoverheid.nl/documenten/rapporten/2024/03/04/programma-energiehoofdstructuur

3. Netverzwaring

- **Energie-Nederland – “Netcongestie kost miljarden: netverzwaring is de oplossing”**
  Link:
  https://www.energie-nederland.nl/netcongestie-kost-miljarden-netverzwaring-is-de-oplossing/ (Energie Nederland)
- **PBL – Informatieblad “Netverzwaring en netcongestie” (ASA 2025)**
  Link:
  https://www.pbl.nl/downloads/pbl-2025-informatieblad-netverzwaring-en-netcongestie-5667pdf (PBL)

4. Flexibilisering van vraag

- **RVO – Flexibilisering-rapport**
  Link:
  https://www.rvo.nl/sites/default/files/2025-03/Rapportage%20Flexibilisering%20Bedrijven%20en%20Instellingen%20Definitief%202.pdf
- **RVO / CE Delft / Merosch – “Oplossingen voor netcongestie bij bedrijven”**
  Link:
  https://www.rvo.nl/sites/default/files/2024-06/Rapport-RVO-CEDelft-Merosch-oplossingen-netcongestie-bedrijven.pdf
- **RVO – Factsheets “Netcongestie bij bedrijven: wat kunt u doen?”**
  Link:
  https://www.rvo.nl/sites/default/files/2024-07/Factsheets-oplossingen-netcongestie-bedrijven-versie-2.pdf
- **TNO – “Preventing grid congestion: how smart devices can optimize electricity usage in the Netherlands”**
  Link:
  https://www.tno.nl/en/newsroom/2024/11/preventing-grid-congestion-smart-devices/
- **TNO – “Net zero energy solutions” (flexibele inzet warmtepompen / EV-laden)**
  Link:
  https://www.tno.nl/en/sustainable/system-solutions-environment/net-zero-energy-solutions/
- **Le Dréau et al. (2023) – “Developing energy flexibility in clusters of buildings: A critical analysis of barriers from planning to operation”**
  Link: https://www.sciencedirect.com/science/article/pii/S0378778823008381
- **Shepherd & Mohagheghi (2024) – “Demand Flexibility: A Review of Quantification Methods, Models, and Required Data”**
  Link: https://www.mdpi.com/2076-3417/14/23/11276 (MDPI)

5. Smart siting, generation-to-load links & network bypass

- **RVO – Oplossingen voor netcongestie bij bedrijven (CE Delft & Merosch, 2024)**
  Link:
  https://www.rvo.nl/sites/default/files/2024-06/Rapport-RVO-CEDelft-Merosch-oplossin

gen-netcongestie-bedrijven.pdf (RVO.nl)

- **RVO – Factsheets “Netcongestie bij bedrijven: wat kunt u doen?”**
  Link: https://www.rvo.nl/sites/default/files/2024-06/Factsheets-oplossingen-netcongestie-bedrijven.pdf (RVO.nl)

- **RVO / Bureau Energieprojecten – Programma Energiehoofdstructuur (PEH, 2024) Link:**

  https://www.rvo.nl/sites/default/files/2024-03/Programma-Energiehoofdstructuur-maart-2024-Programma-Energiehoofdstructuur.pdf

- **RVO – “Welke mogelijkheden heeft u bij netcongestie?”**
  Link: https://www.rvo.nl/onderwerpen/netcongestie/mogelijkheden-bij-netcongestie (RVO.nl)

- **Papadimitriou et al. (2023) – energy hubs**
  Link: https://www.mdpi.com/1996-1073/16/10/4018

- **Javanmardi et al. (2025) – ruimtelijke complexiteit in nationale energiesystemen**
  Link: https://www.sciencedirect.com/science/article/pii/S1364032125001431