

# *Adaptive energy transition moonshot* EnergyDeltaPlan

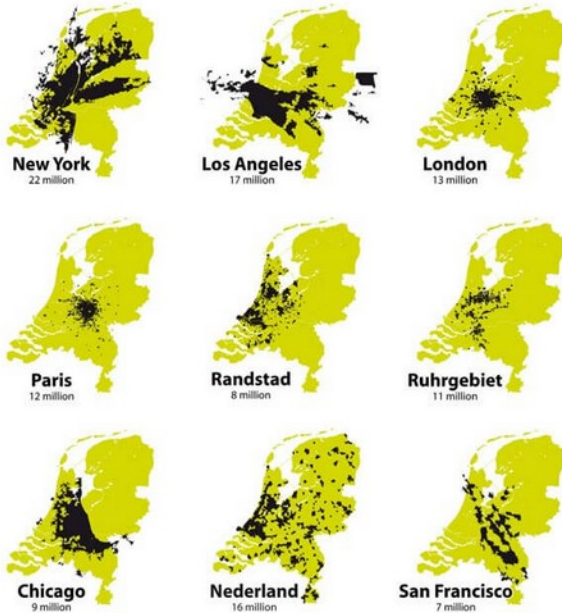
Dr. ir. Igor Nikolic  
11-06-24

Associate professor  
Head of Systems Engineering and Simulation section  
Multi-Actor Systems Department  
Faculty of Technology, Policy and Management, TU Delft  
Email: [i.nikolic@tudelft.nl](mailto:i.nikolic@tudelft.nl)  
Web: <https://ComplexEvo.org>  
<https://www.linkedin.com/in/igornikolic/>

# Nature of the energy transition problem

Holland is not a dense country, but an empty city.

Nederland is geen vol land, maar een lege stad.



Source unknown, internet

- Deeply uncertain
  - technology, behaviour, climate/weather, (geo)politics
- Heterogeneous
  - Industry : Vast (local) production and consumption, remote decision makers
  - Households: diverse, values & emotion, locked-in
- Essential, “boring”, slow, expensive and “forever”
  - 380KV: ~ 10 year to build, ~6M€/GW/km, ~50-100 years
  - Deep interconnection with all other systems
- Culture
  - “Must Always Work”, maintenance first, deterministic planning
  - Markets on natural monopolies, financial benchmarking

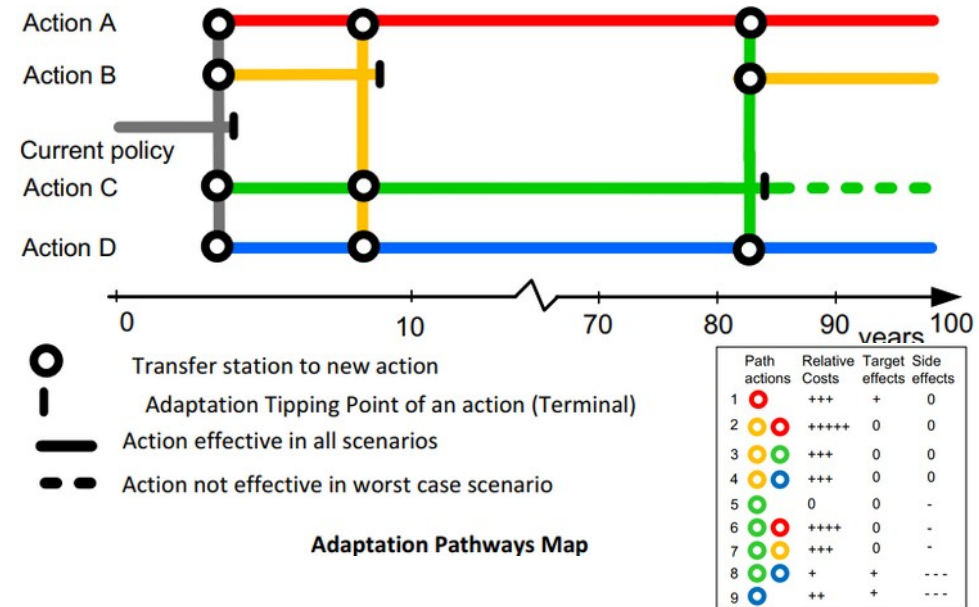
# What is the problem?

- World is deeply uncertain
  - what is the value of key parameters?
  - Do they even matter?
- Large investments :
  - Can be done only once
  - High risk of being stranded or blocking development
- Decisions now
  - (mainly) from one perspective / organization
  - lack of system integration perspective
  - high organizational interdependence

# What is needed? Adaptive planning!

- We need integrated plans that are
  - designed to change
  - can handle most / as many as possible future developments
- Continuous process of
  - identifying possible futures
  - exploring and stress-testing of plans
  - monitoring and adaptation of plans

We are already doing it in the Deltaprogramma!



# Why don't we have it yet in the energy domain?



# Moonshot

- *def:* moonshot *noun*
  - **an extremely ambitious project or mission undertaken to achieve a monumental goal**
- A vision I believe is achievable
- Not *per se* a plan, but a system level perspective
  - that can help us get organized to achieve a sustainable energy transition
- something to challenge existing ideas and focus the discussion

# Moonshot : Robust, adaptive energy-delta plan

- National scenario space
  - What could, is likely and we want to happen?
- National data infrastructure
  - Shared, unified and transparent facts and figures
- National Multi-model infrastructure
  - Multi-models platform, models, assumptions and stress-testing of plans
- Sense making, interpretation and plan development
  - Linking of political debate to analysis and action
- Monitoring and adaptation of plans
  - Adaptation, right-sizing, correction & capitalizing on learning



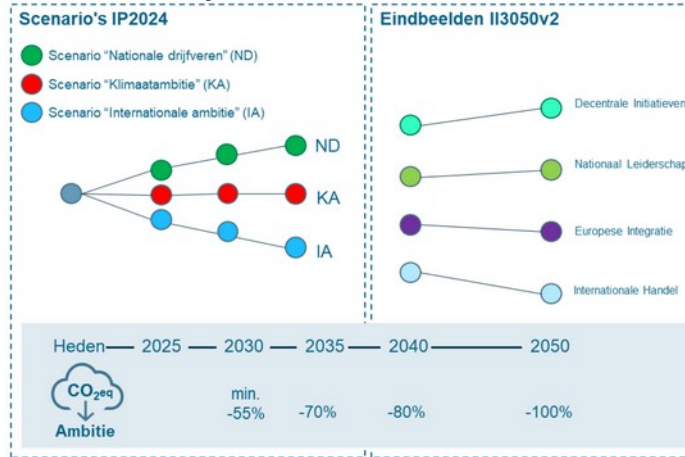
# Moonshot: National Scenario Space



Many (>10<sup>20</sup>) nonlinear, path dependent "future histories"

- Uniquely identifiable future development paths for the energy system
- Plausible futures
  - What could happen?
- Expected futures
  - What is likely to happen?
- Desirable futures
  - What is the future we want?

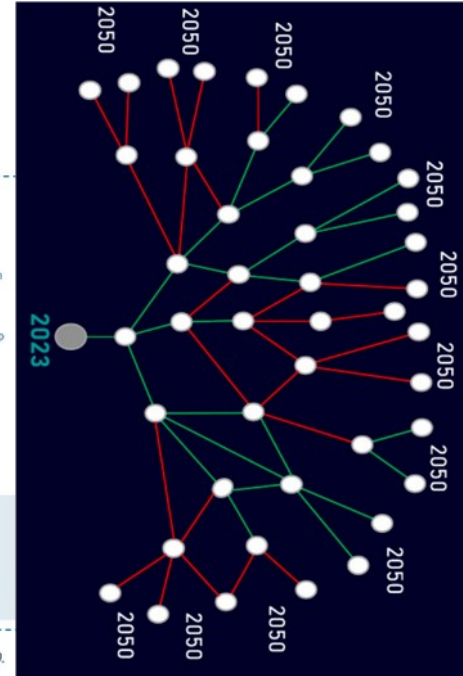
Limited number (<5) of end states or linear storylines



Figuur 1. Samenhang tussen de scenario's voor IP2024 en de eindbeelden voor de tweede versie van II3050.

Source: [Het energiesysteem van de toekomst: de II3050-scenario's Integrale energiesysteemverkenning 2030-2050](#)

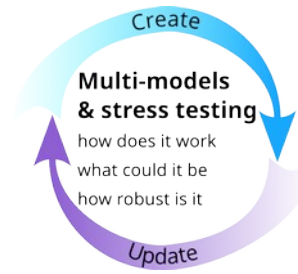
Source: Gridmaster project report



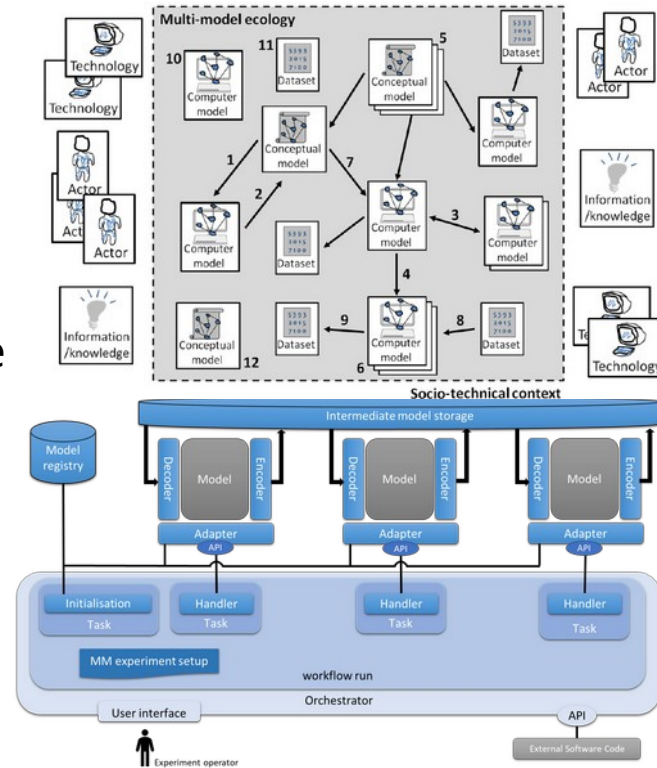




# Moonshot: National Energy (Multi-) model infrastructure



- Multi-models allow for integrated system perspective
  - across scales, systems & themes
- Much simpler and highly systematic model use & reuse
- Exponential increase in insight
- Transparent, repeatable way to connect models, within same scenario space and same data sets
  - multi-model.nl and other efforts
- Automatically stress test plans across many (1K-100K) different scenarios



# Moonshop: Sensemaking, interpretation and plan development process



- Collective reasoning on stress test outcomes across many possible futures
- Iterative, multi-level, stakeholder process
- Plan development progress
  - Explicitly design for flexibility and robustness
  - Connect adaptation to other investment agendas
  - Identification of key variables / triggers for changing plans

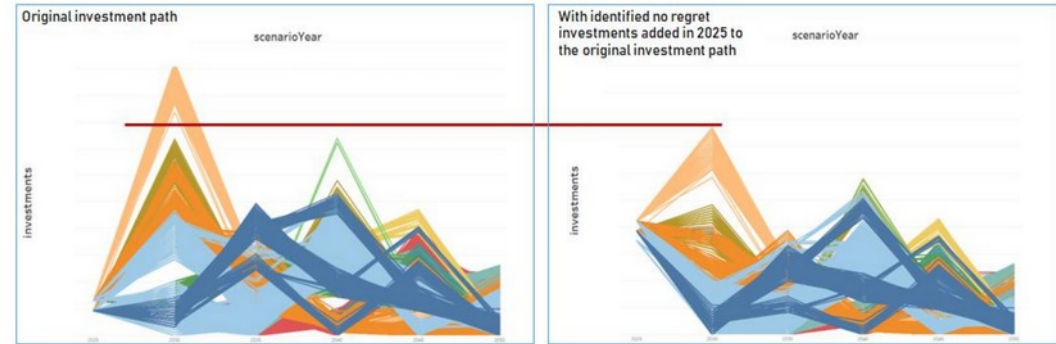


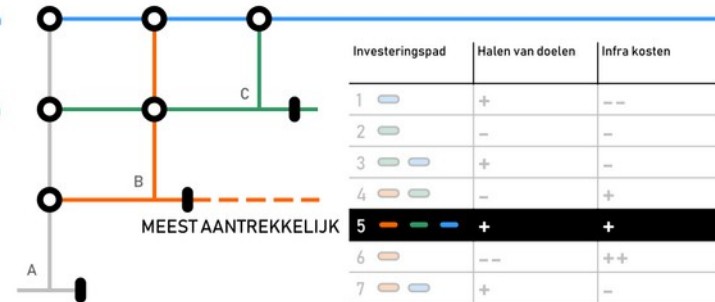
Figure 43: illustration of the impact of the addition of robust investments in 2025: a reduction of the potential investment peak in 2030.

## Adaptieve investeringspaden voor H<sub>2</sub>-infrastructuur (fictief voorbeeld)

40 GW nieuwe H<sub>2</sub> pijpleiding Maasvlakte - Wijngaarden

20 GW nieuwe H<sub>2</sub> pijpleiding Maasvlakte - Wijngaarden

4 GW hergebruik aardgasleiding Botlek



Huidige situatie

# Moonshot: Monitoring infrastructure



- Monitoring key variables identified by scenarios and model stress tests
- Identifying new
  - uncertainties and risks
  - development patterns
- Alerting and triggering the adaptation of plans
- Updating the scenario space with new developments



## 4.2. Periodieke actualisatie

Het NPE wordt binnen Nationale beleidscyclus Klimaat & Energie gemonitord, geëvalueerd en geactualiseerd. Dit versterkt de regie vanuit het kabinet op het behalen van gestelde doelen en borgt de controlerende taak van het parlement. De monitoring en actualisatie past binnen de begrotingscyclus en er wordt zo veel mogelijk aangesloten op bestaande monitorings- en verantwoordingsprocessen, zoals de Monitor Klimaatbeleid, de Klimaat en Energieverkenning (KEV), de Klimaatnota en de INEK.

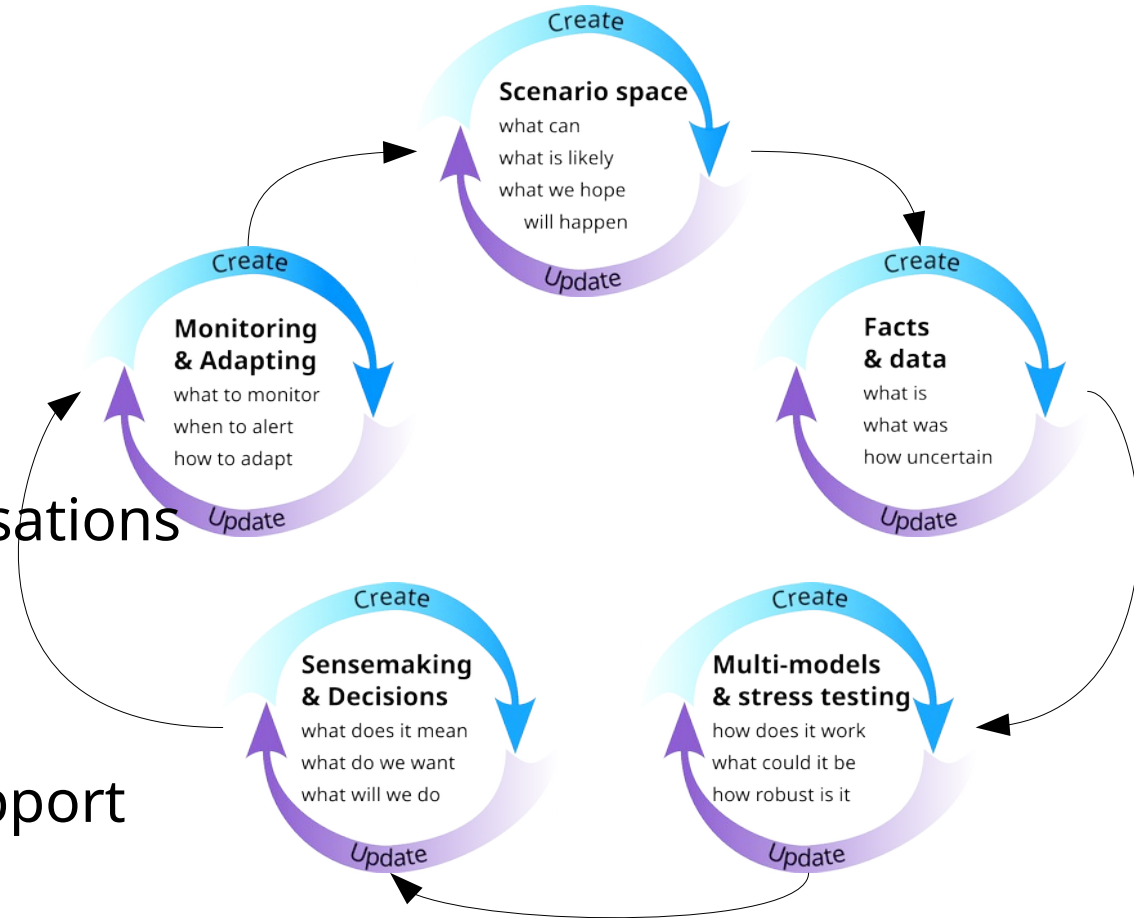
Hieronder staan een aantal onderdelen van de beleidscyclus kort toegelicht:

- **Jaarlijkse monitoring en evaluatie:** De Tweede Kamer wordt jaarlijks door het kabinet geïnformeerd over de voortgang van het realiseren van plannen uit het NPE en over eventuele bijsturing indien noodzakelijk.
- **Jaarlijkse Energienota.** De Monitor energiesysteem en de KEV zijn vervolgens input voor de Energienota. Daarin geeft het kabinet een appreciatie van de voortgang van het afgelopen jaar afgezet tegen de beoogde (tussentijdse) resultaten richting 2050. Hiermee legt het kabinet verantwoording af over het huidige energiebeleid. De eerste Monitor energiesysteem en Energienota worden in 2024 verwacht
- **Vijfjaarlijkse evaluatie en actualisatie:** Het NPE wordt ten minste elke vijf jaar geactualiseerd. Dit sluit aan bij de in de Klimaatwet vastgelegde cyclus voor het vaststellen van het Klimaatplan en de in EU-verband vastgelegde verplichting om een

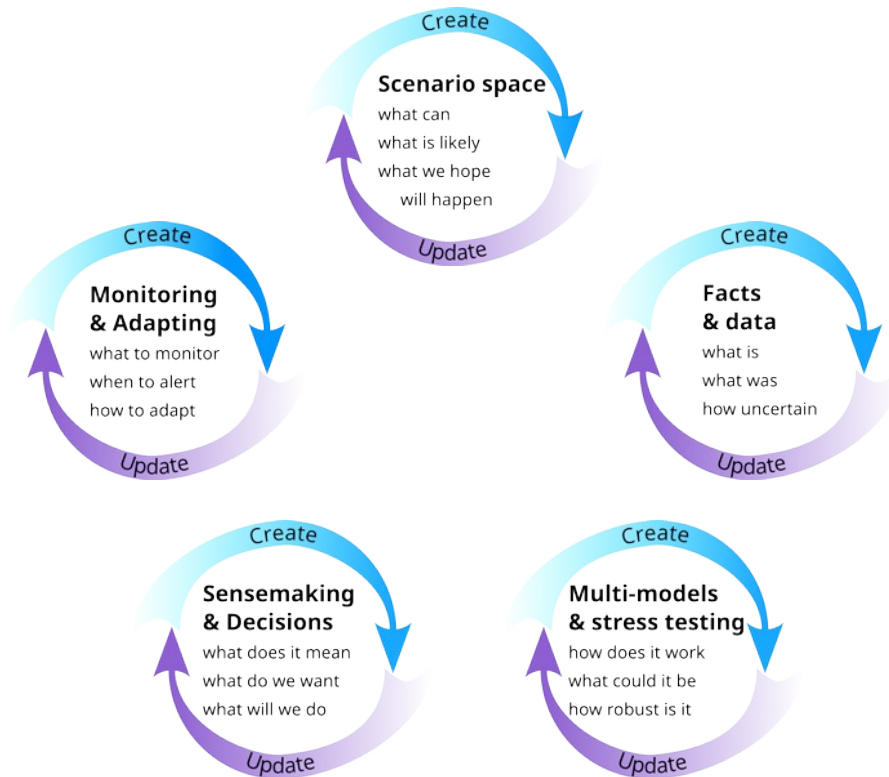
- **“Monitor energiesysteem”  
as part of the NPE is an great development**

# Concluding

- Adaptive planning process for *robust decision making under deep uncertainty*
- Works
  - within and between organisations
  - across the energy system
  - at national level
- Requires
  - long term institutional support
  - change of mindset
- **We can do it!**



# Thank you!



[i.nikolic@tudelft.nl](mailto:i.nikolic@tudelft.nl)