10th Trondheim CCS Conference

Project no 271501, ACT – Accelerating CCS technology

Planning CO_2 transport and storage infrastructure in the Netherlands offshore

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Objective and context

- To develop transport and storage scenarios for the Rotterdam Harbour Area
- Aligned with NL objectives to capture and store CO2 from industrial installations up to 7 Mtpa
- Porthos consortium (Rotterdam) considers 5 Mtpa scenario which could grow to 10 Mtpa or more after 2030
- Earlier work was presented at GHGT-14 in Melbourne
- Additional work with the use of an expanded version of the ECCO tool and new cost data from EBN report in 2017

Current CCS activities in the netherlands

- Rotterdam harbour: Porthos consortium
  - 20% of national emissions
  - Develop into ‘green port’
  - Continue economic activity under increasingly strict greenhouse gas emission regulations
  - Target ~5 Mtpa by 2030; to grow beyond 2030

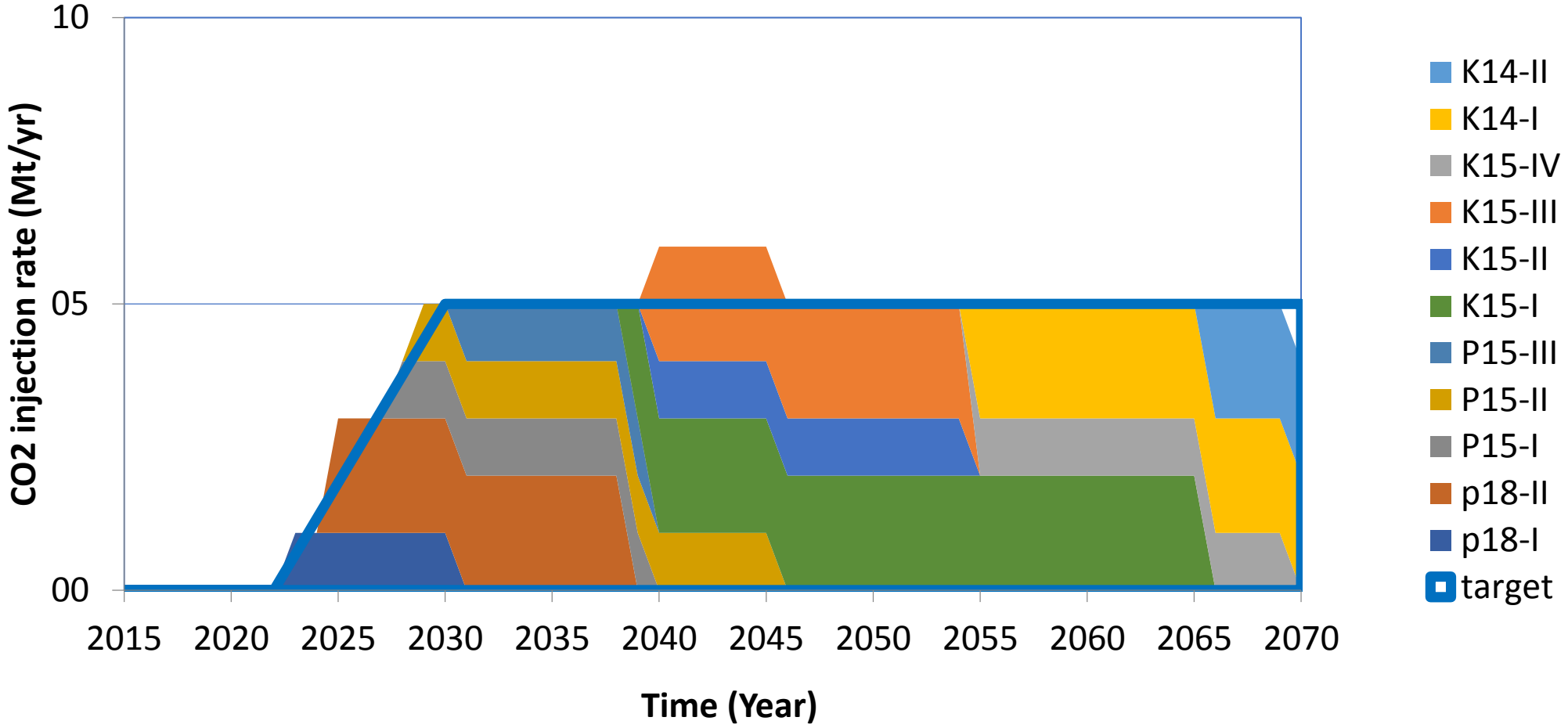
Transport and storage of CO_2 in NL, 2017

Considered network development scenario

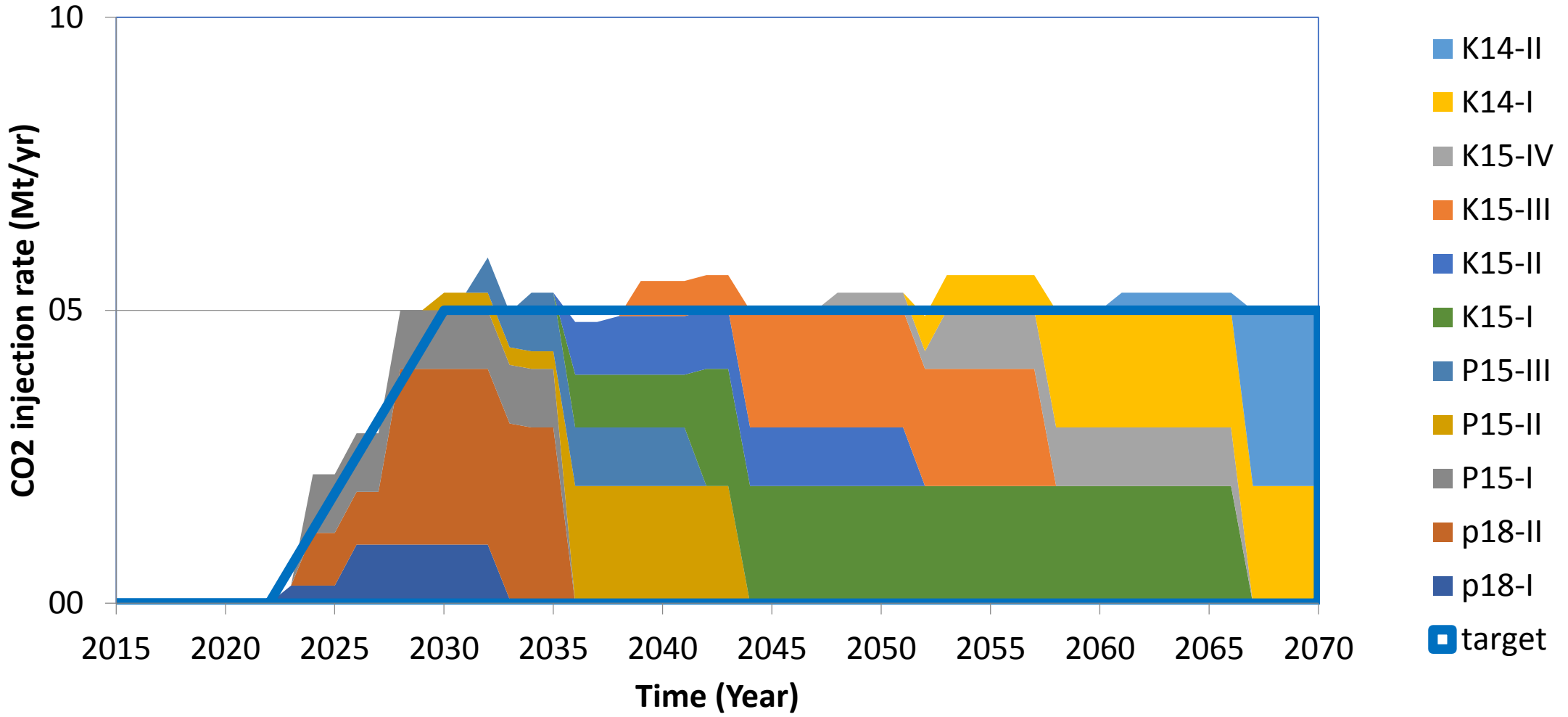
- CO_2 supply from Rotterdam region
- First element (‘A’) currently being designed
- Design element ‘A’ depends on choices made for later elements

- Network development depends on:
  - Unit costs of storage and transport
  - Risk assessment of clusters and fields
  - Availability of fields, platforms & wells
  - Storage capacity & injection rates

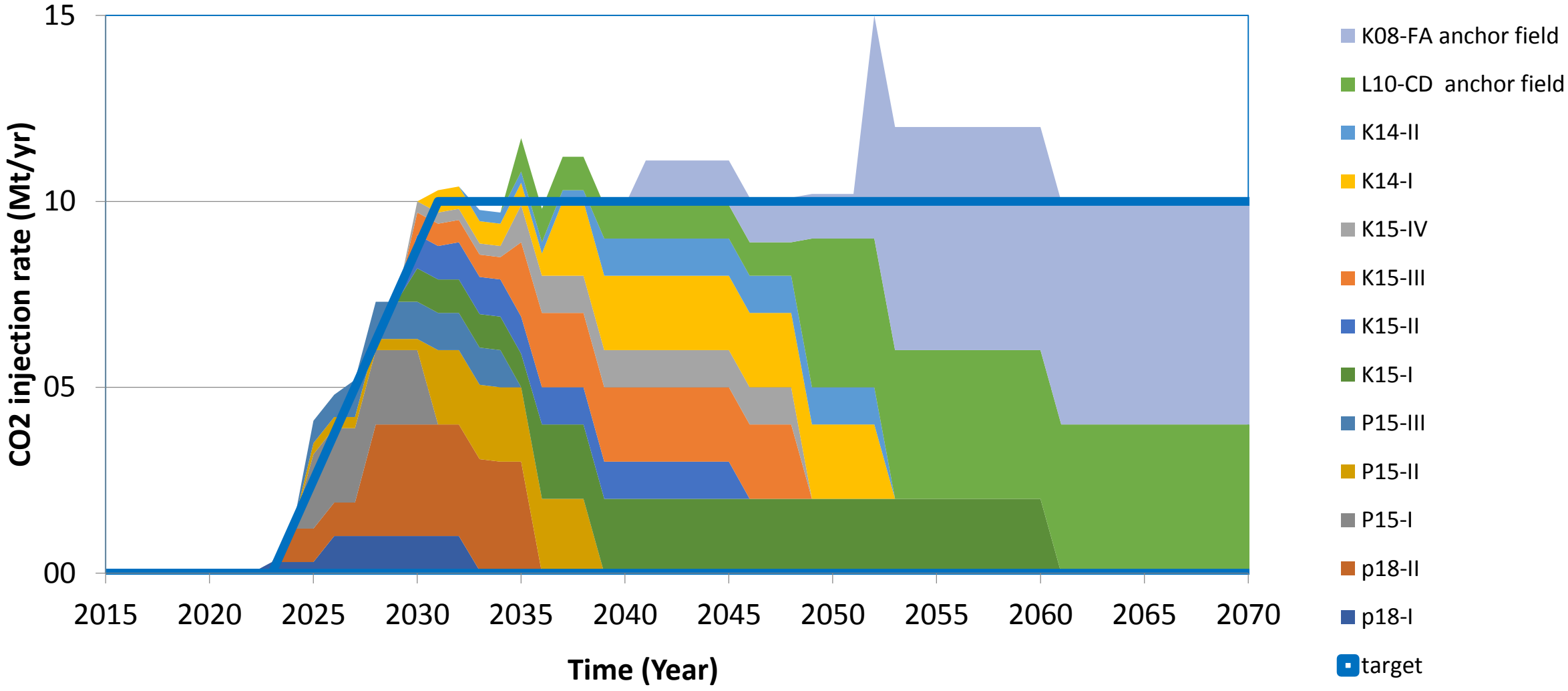
5 Mtpa scenario can be easily accommodated.



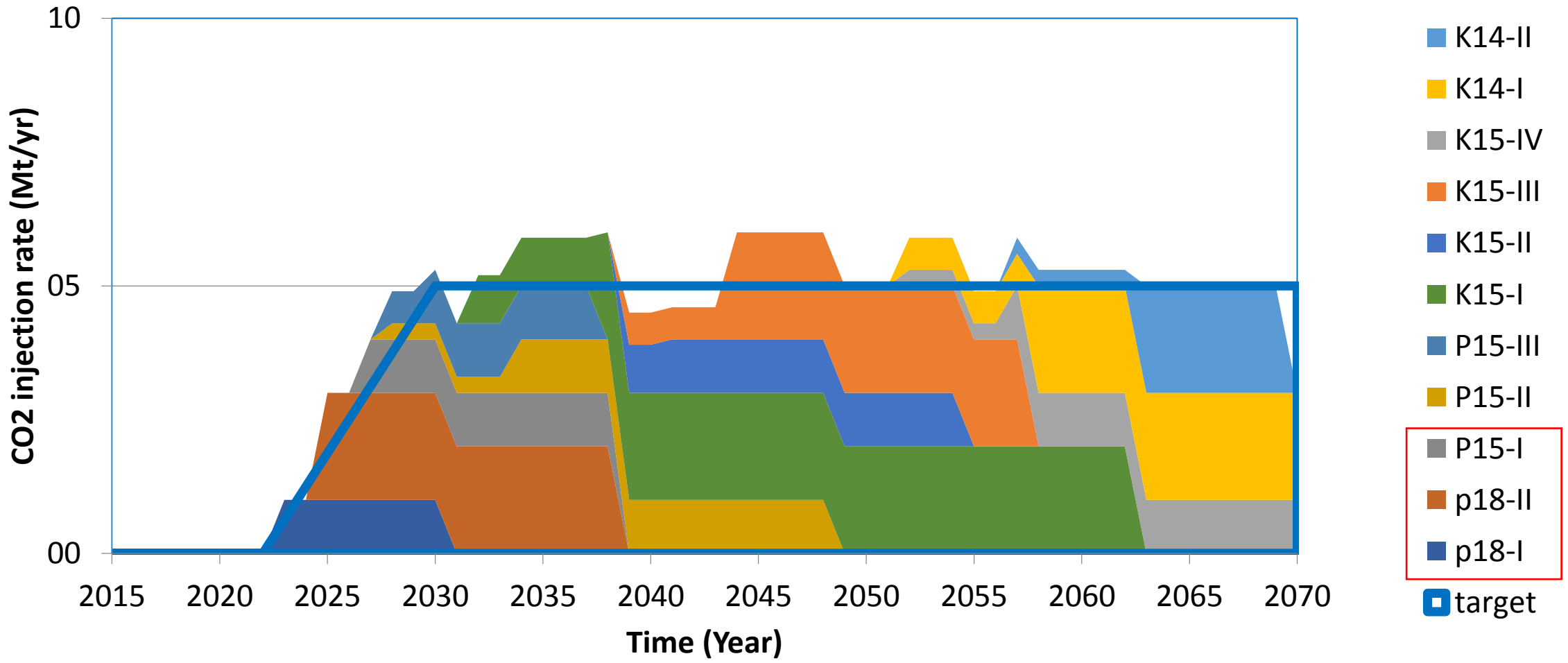
5 Mtpa scenario – Lower rates at BHP < 50 bar



10 Mtpa with constrained injection rate



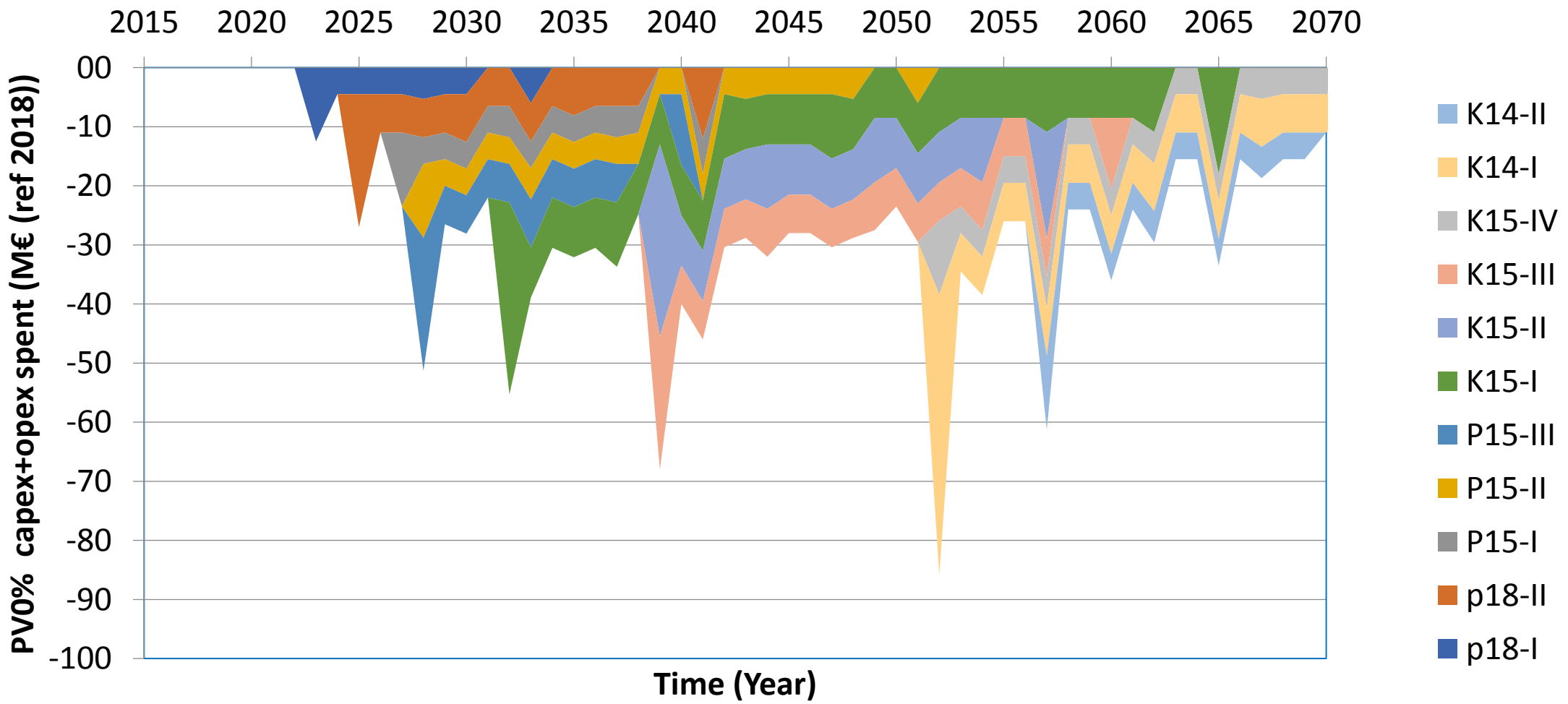
Cost analysis with warm CO_2 injection in 3 reservoirs (I)



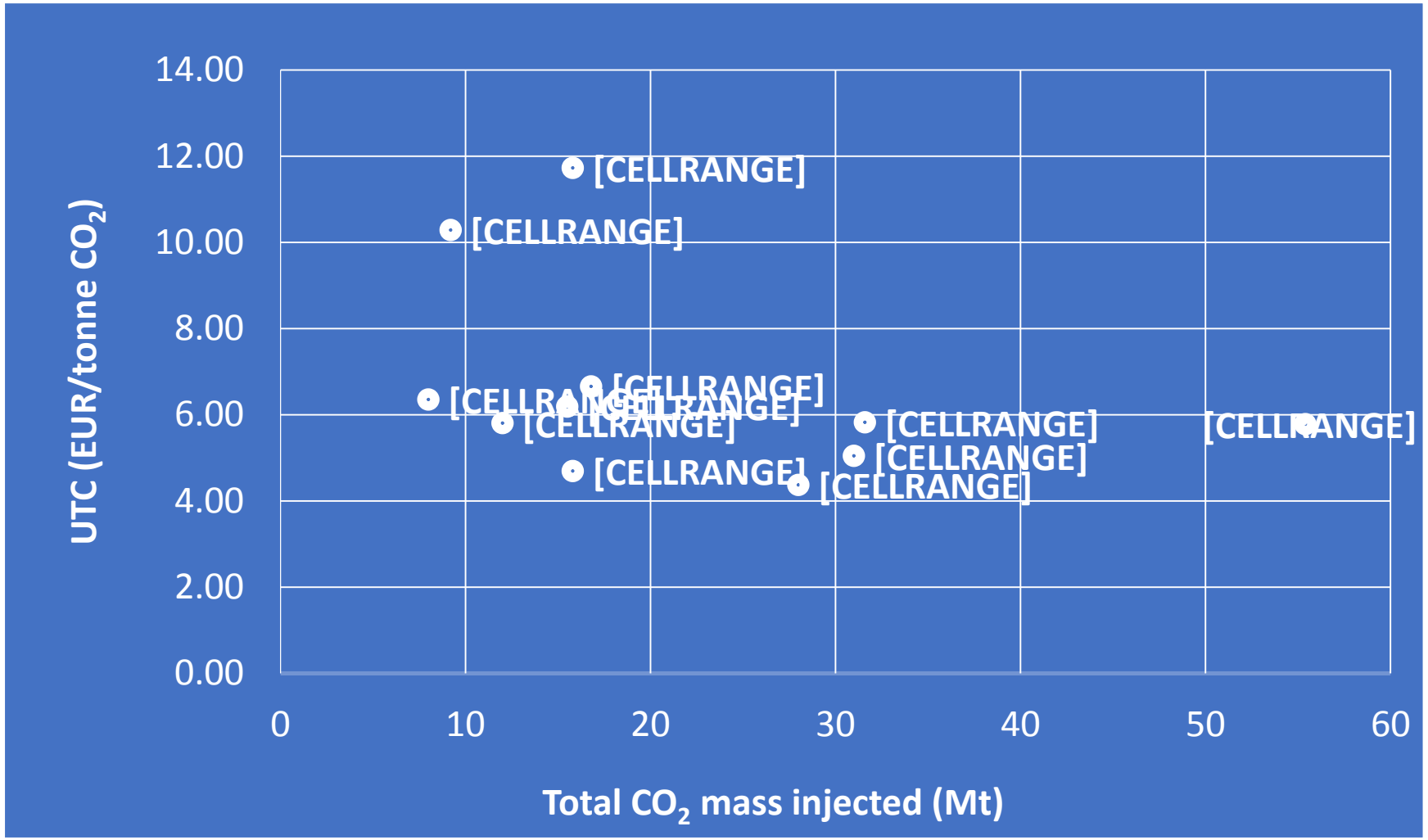
Cost data (modified after EBN, 2017 & ROAD, 2018)

Well and field-related costs	Unit	Value
Drilling & completion capex per well	M€/well	21
Workover cost per well (opex)	M€/well	0.8
Average time between workovers for a well	y	5
Well opex	M€/well/y	2
Transfer to injector cost	M€/well	8
Modification satellite platform	M€/cluster	11
Modification export platform	M€/cluster	15
New satellite platform (4-well monotower)	M€/cluster	22
New export platform (6-well monotower)	M€/cluster	25

Storage Capex and Opex – undiscounted (II)



Unit Technical Costs of storage (EUR/tonne CO_2) (III)

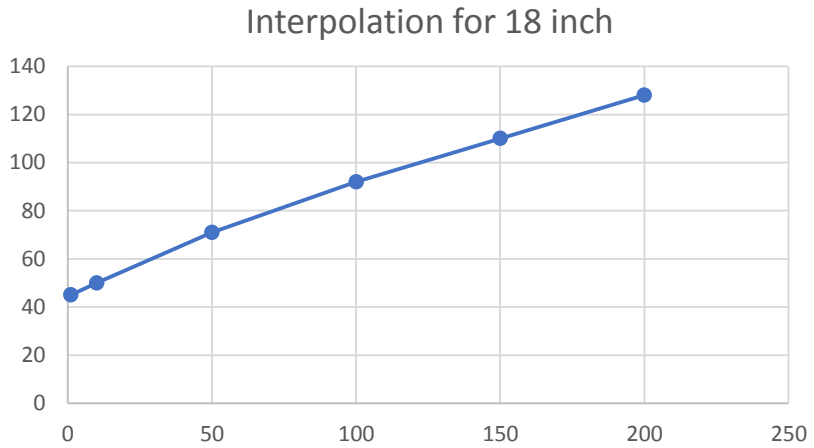


- Excluding compression and transport costs

Cost data for transport infrastructure
(modified after EBN, 2017 and ZEP; no insulation)

Capex

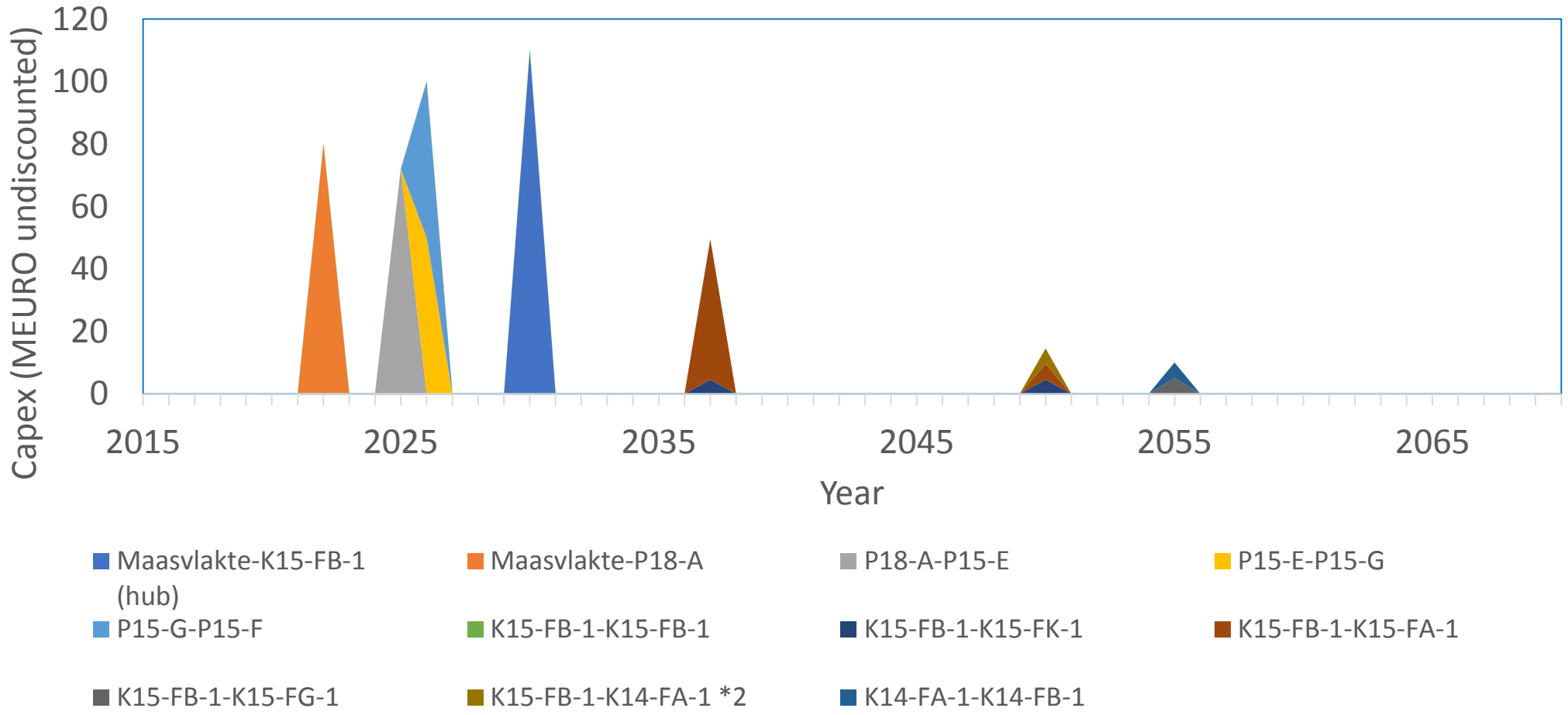
Diameter (inch)	Distance (km)	MEURO
18	10	50
18	50	71
18	100	92
18	150	110
18	200	128



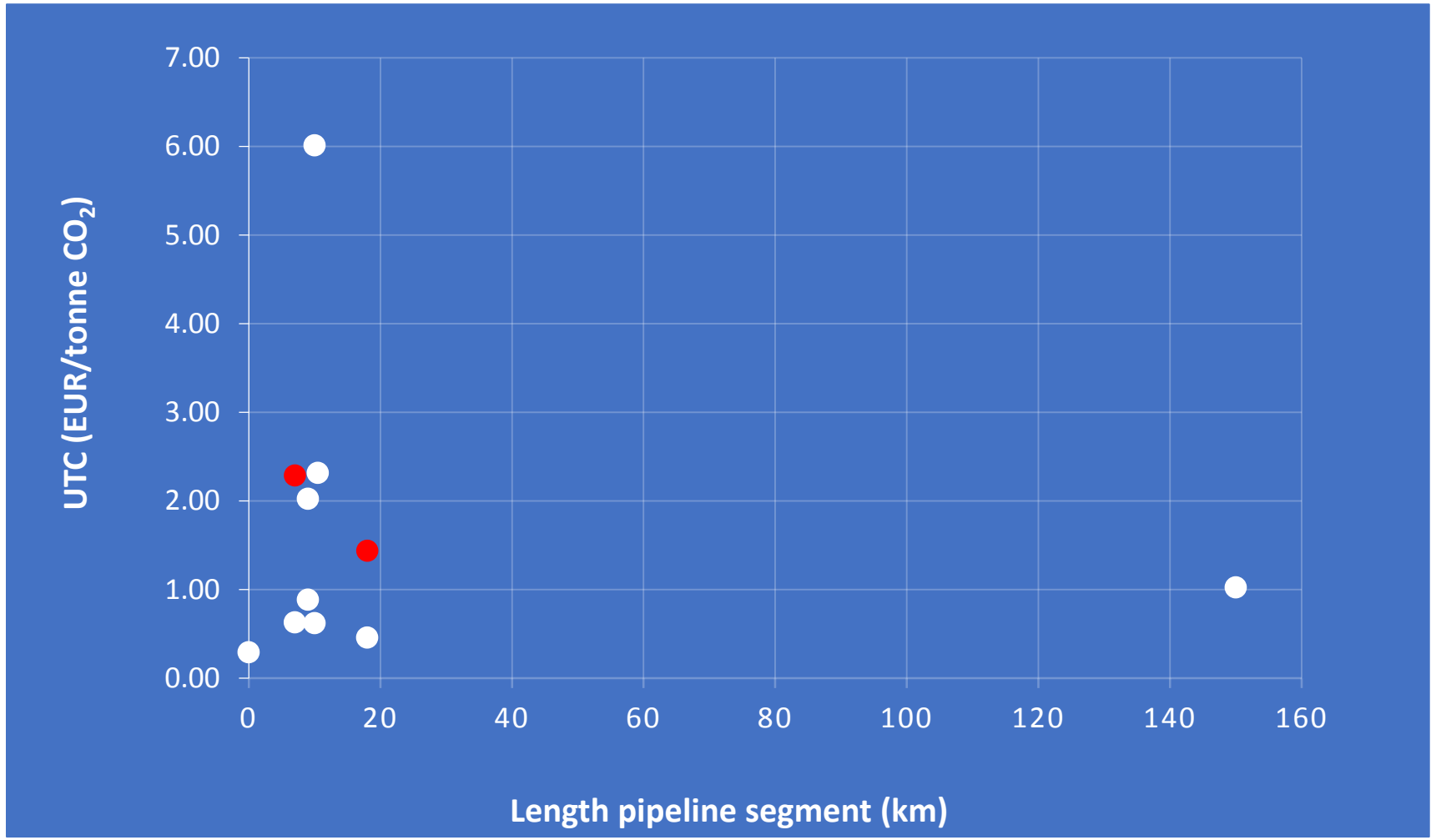
Opex

- Based on fixed 0.25% of Capex
- 29% based on variable CO_2 throughput

Transport costs with insulated pipeline segments for 3 reservoirs (5 Mtpa scenario)



Unit Technical Costs for pipeline segments



- Unit Technical Costs for pipeline infrastructure (without compression):

  2.5 EUR/tonne CO_2

● With insulation

Conclusion

- **Sufficient storage capacity** is timely available for 10 Mt scenario.
- It is a **logistical challenge** to develop and operate 5 to 10 reservoirs in parallel (depending on the target injection rate and constrains in the rate).
- **UTC for storage** is mostly around 4 to 6 EUR/tonne CO_2 which is well comparable to the outcomes in EBN & Gasunie (2017).
- **UTC for transport** without compression is around 2.5 EUR/tonne CO_2,which is slightly higher than in EBN & Gasunie (2017).
- **Thermal insulation** of pipelines provides more flexibility but can be costly depending also on the CO_2 throughput.

- Note that the actual tariffs will differ significantly from the presented technical costs analysis (up to factor 2).

Acknowledgements

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