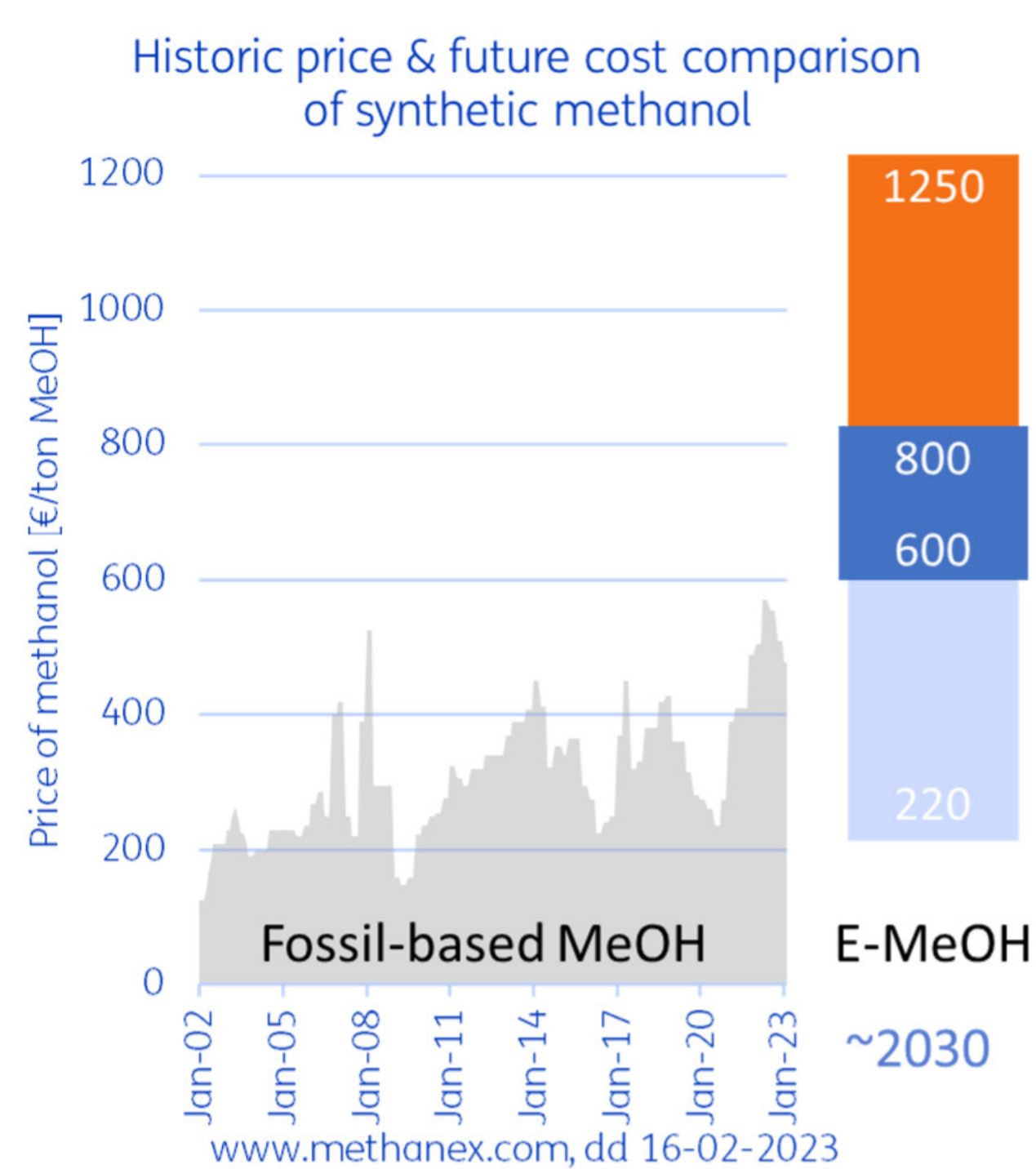


INTERNATIONAL P2X VALUE CHAIN COST ANALYSIS

tim.speelman@tno.nl / thomas.hajonides@tno.nl

CONTEXT

In our transition to a durable future society we need to produce chemical products sustainably on a large-scale to serve the global markets while meeting climate goals. Both industry and governments work hard to address the emerging challenges:



Industry is to adopt new clean technologies. Slow pace needs acceleration in order to maintain licenses to operate. Speeding up can be achieved by an increased understanding of (I) international value chains and ecosystems and (II) investment and operational drivers and barriers: Impact on strategic business models and spatial planning, and the implications of change on energy, feedstock and production operations. Governments are seeking to (partially) facilitate those changes and align them with societal goals. Priority setting in international value chain developments is essential for effective public policy.

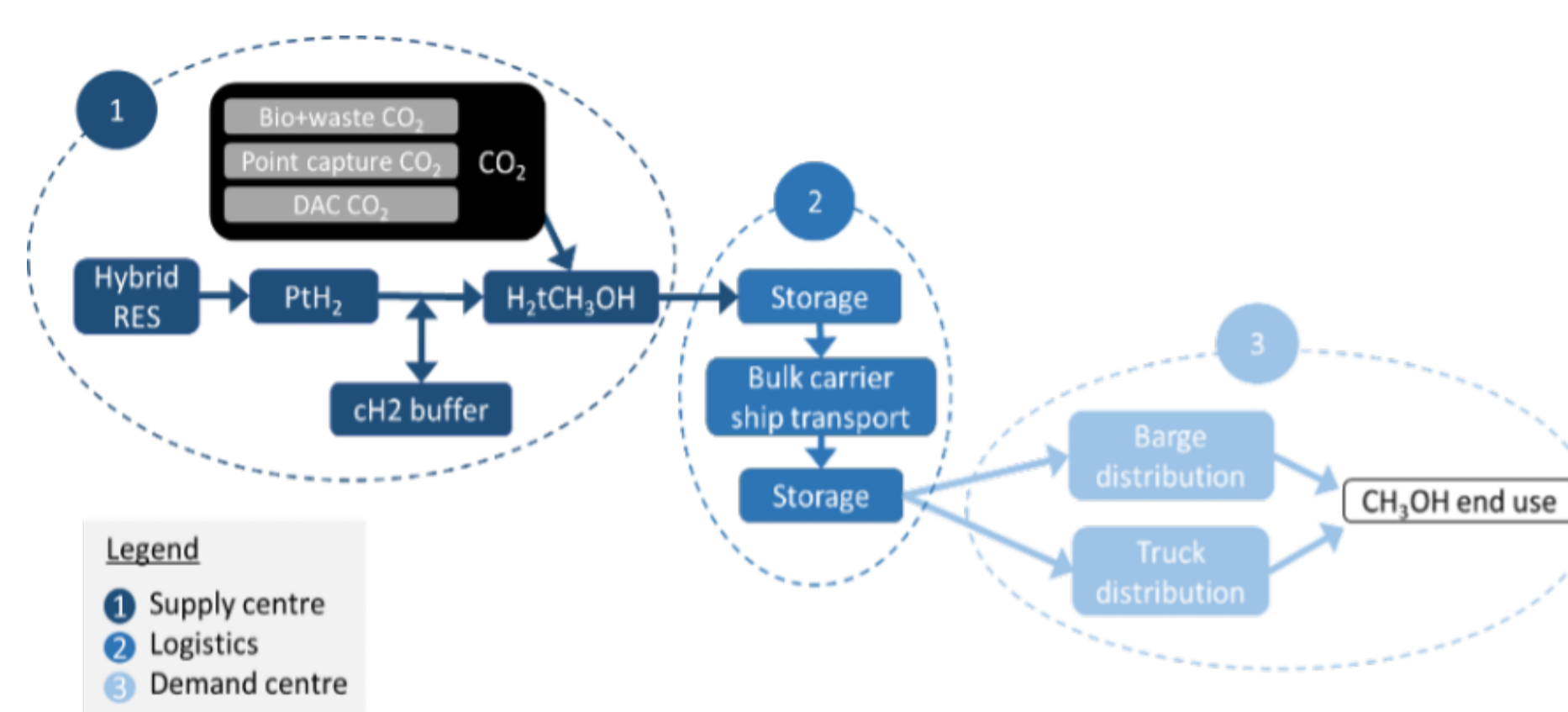
STATUS PROPOSITION

We support corporate and governmental decision-making through quantitative analysis and by being a discussion partner by:

1. Creating overviews of value chain alternatives for hydrogen, ammonia, methanol, FT-diesel, FT-kerosene.
2. Assessing the techno-economic performances of value chains with a focus on investments, operational costs and product quality
3. Providing insights on (i) the sensitivity of cost estimates, (ii) technological innovation needs and (iii) the consequences of technology innovation learning curves on value chain KPIs.
4. Continuously increase the data quality, and improvement of assumptions, w.r.t. novel

technologies and modelling logic.

The current scope & supply chain configuration building blocks is illustrated with the example of a synthetic methanol import chain is illustrated below:



OBJECTIVES

The Renewable Molecule Supply Chain Analysis team sets out to connect value chain partners with information, tools and advise to enable partners to take objective, fact-based decisions while considering the diversity of perspectives needed.

The focus for the upcoming years shifts from hydrogen carrier (import) value chains to higher-value and more complex molecules.

OPPORTUNITIES

The global energy and material transition offers business opportunities. Increasing the understanding of pre-feasibility value chain performance facilitates decision-makers to prioritize and decide on near-future strategy and policy-making on topics such as:

- How feasible is feedstock/intermediate import vs. its local production?
- Comparing decarbonization potential of international value chains: which value chain (technology) should be prioritized in scaling up the chain?
- Which value chain stakeholders can build coalitions of the willing and move forward with (investment) decisions collectively to reduce risks and uncertainties?

CHALLENGES

Prioritize between value chain configuration options and decide on value chain development has many challenges. One challenge is highlighted: entering existing energy markets and be(come) competitive. Figure XX illustrates this challenge by relating the estimated cost ranges of synthetic methanol to history prices.

DEVELOPMENT PLAN

To determine the (near) future value chain competitiveness, analysis are recommended to move beyond their techno-economic scope by adding PESTLE-perspective value creation on top of financial added value:

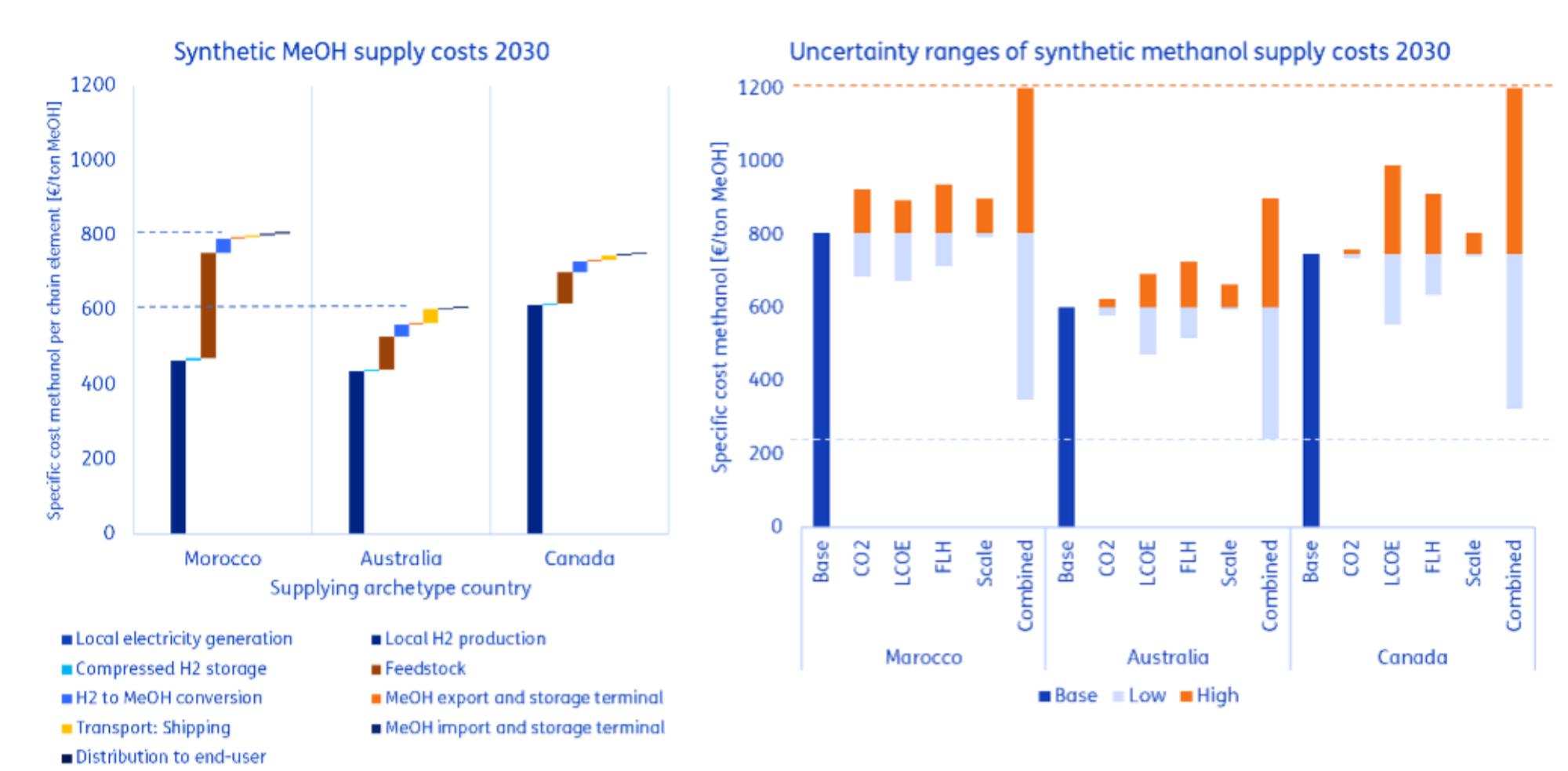
- Add Environmental performance indicators to bring analysis back to the key objective of the transition.
- Explore the merits of reallocation/redistribution of value chain element 'activities' globally: how to design value chains with security of product supply as a key design criteria.

INFRASTRUCTURE/PARTNERS

The Supply Chain Model tooling has been in continuous improvement cycles from 2020 onwards in close collaboration with industry partners during feasibility studies and cost projections. You are kindly invited to reflect on the logic and assumptions underlying the cost analysis tooling: the wisdom of the crowd principle is embraced wholeheartedly in the Power2Integrate program line.

RESULTS / PROJECTS

Between 2019 and 2023 over 10 projects have been completed with significant contributions of the Supply Chain Model tooling developed within the Power2Integrate program. One example of results is highlighted below.



Project conclusion: Synthetic methanol import cost estimates depend strongly on the country of origin and the bandwidth of uncertainty is significant.