

# Understanding the Environmental implications of LNG supply chains

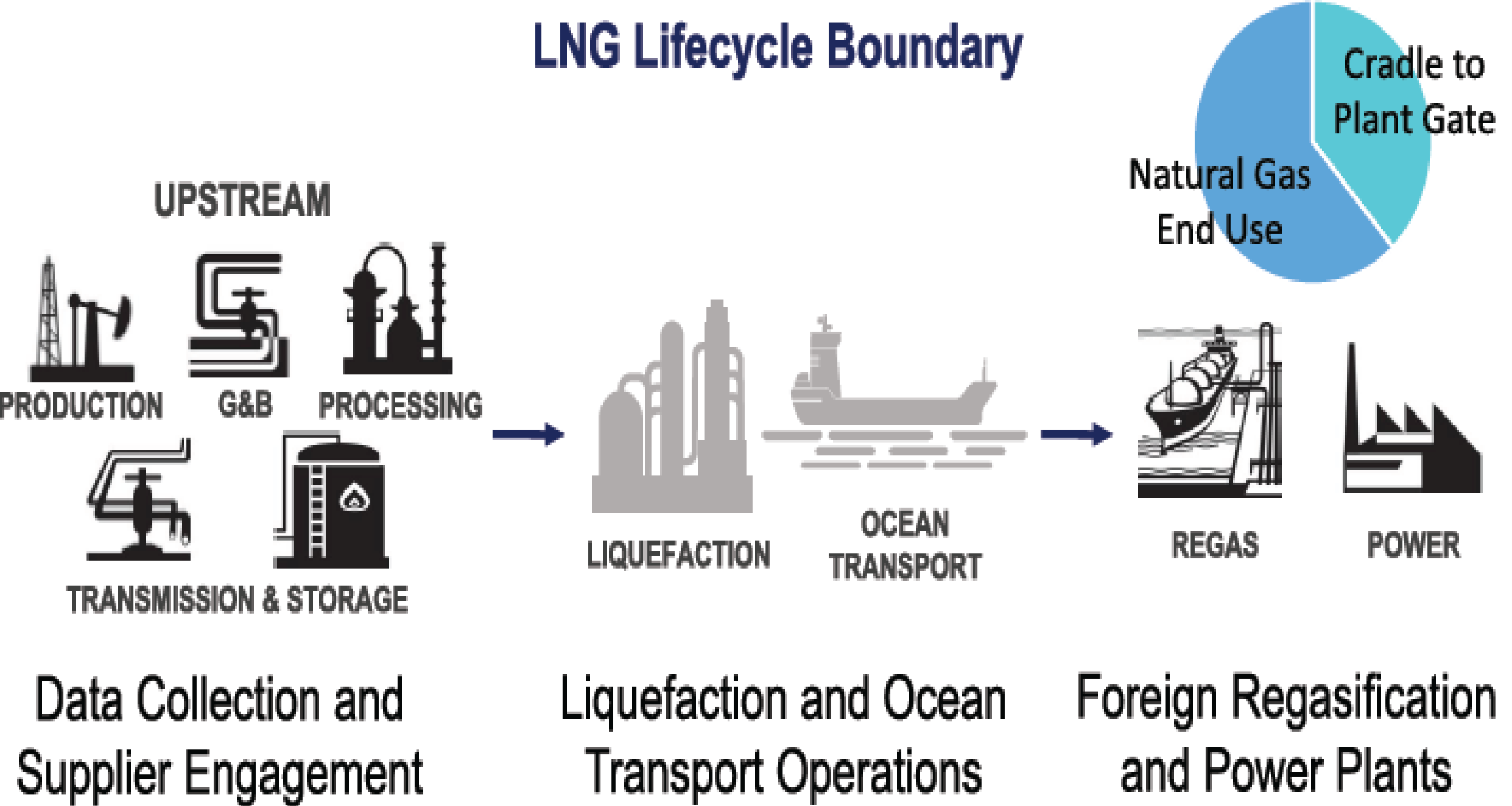
## Defining a Research Agenda

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Environmental Defense Fund

# LNG Lifecycle Boundary



From Roman-White et al. 2021

# Environmental Impacts of LNG

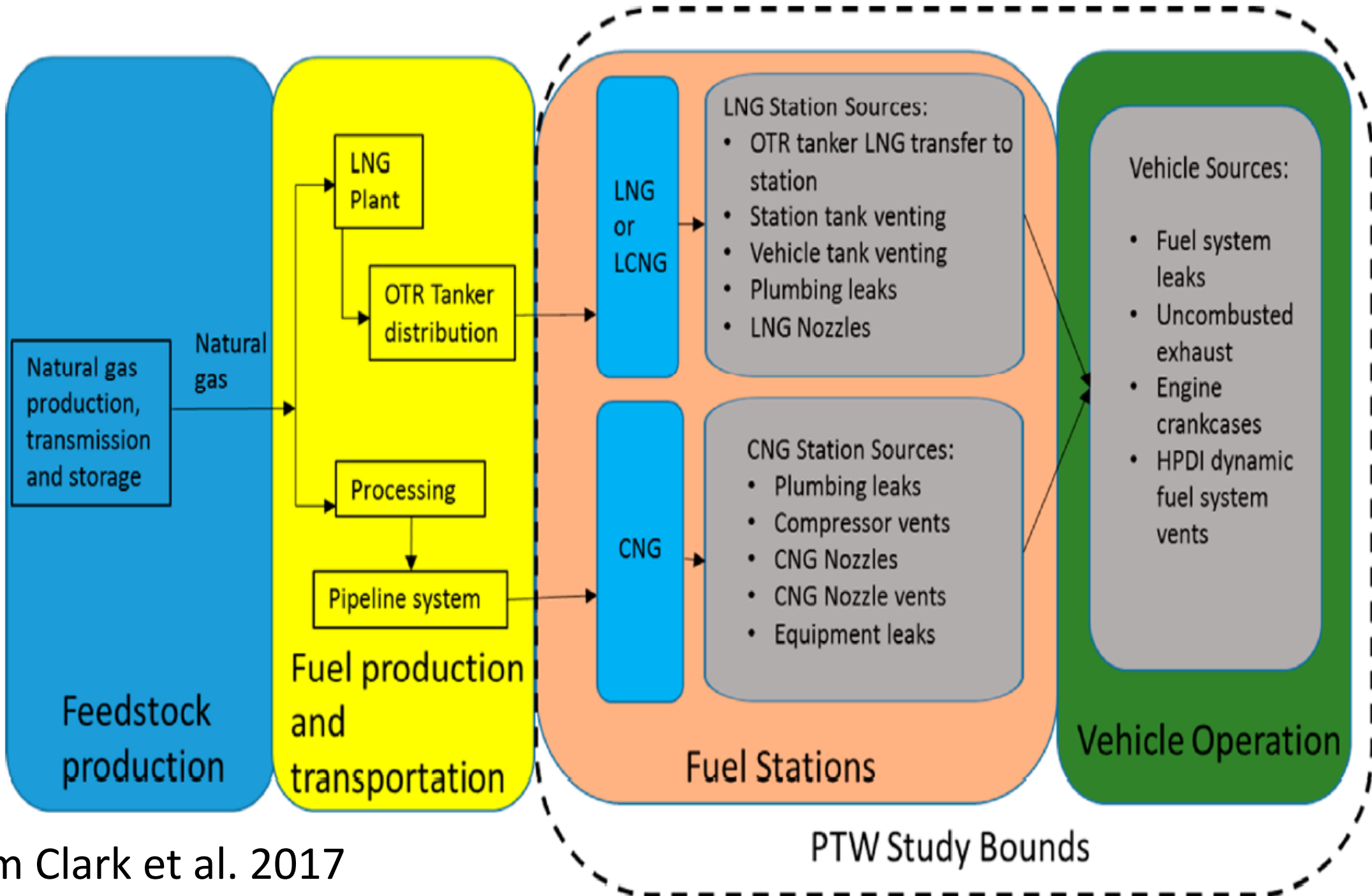
- Emissions
- Greenhouse Gas Emissions
- Embodied Energy

# Boundary conditions are critical

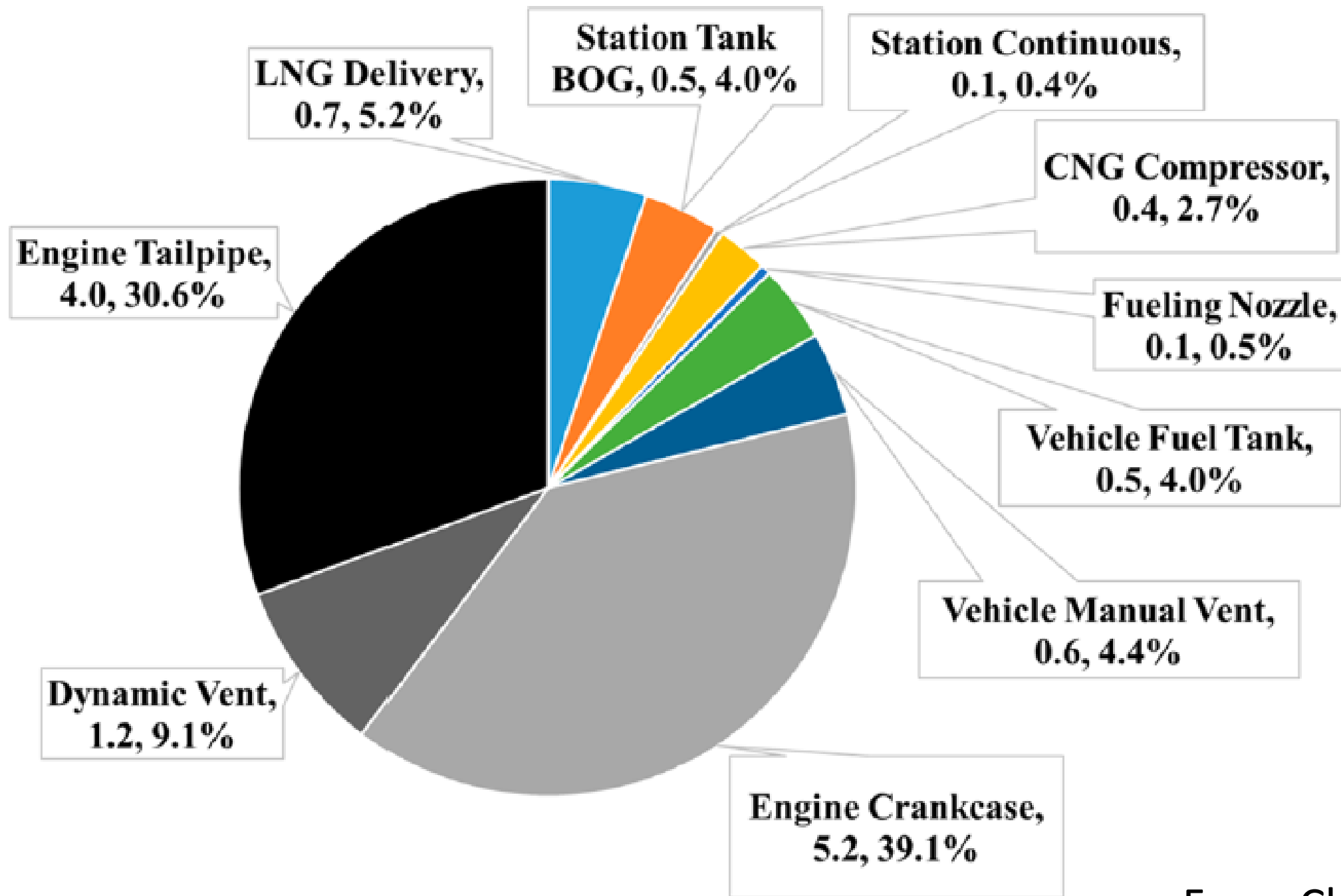
- What is included and what is not?
- A robust analysis implies that changing the boundary conditions does not materially effect the analysis
  - Spatially
  - Full value chain
  - Diverse operating conditions
  - Time frame
- Metrics really matter
  - What time span should be considered?
    - CO2e is very problematic
    - Timeframe should align with policy objective

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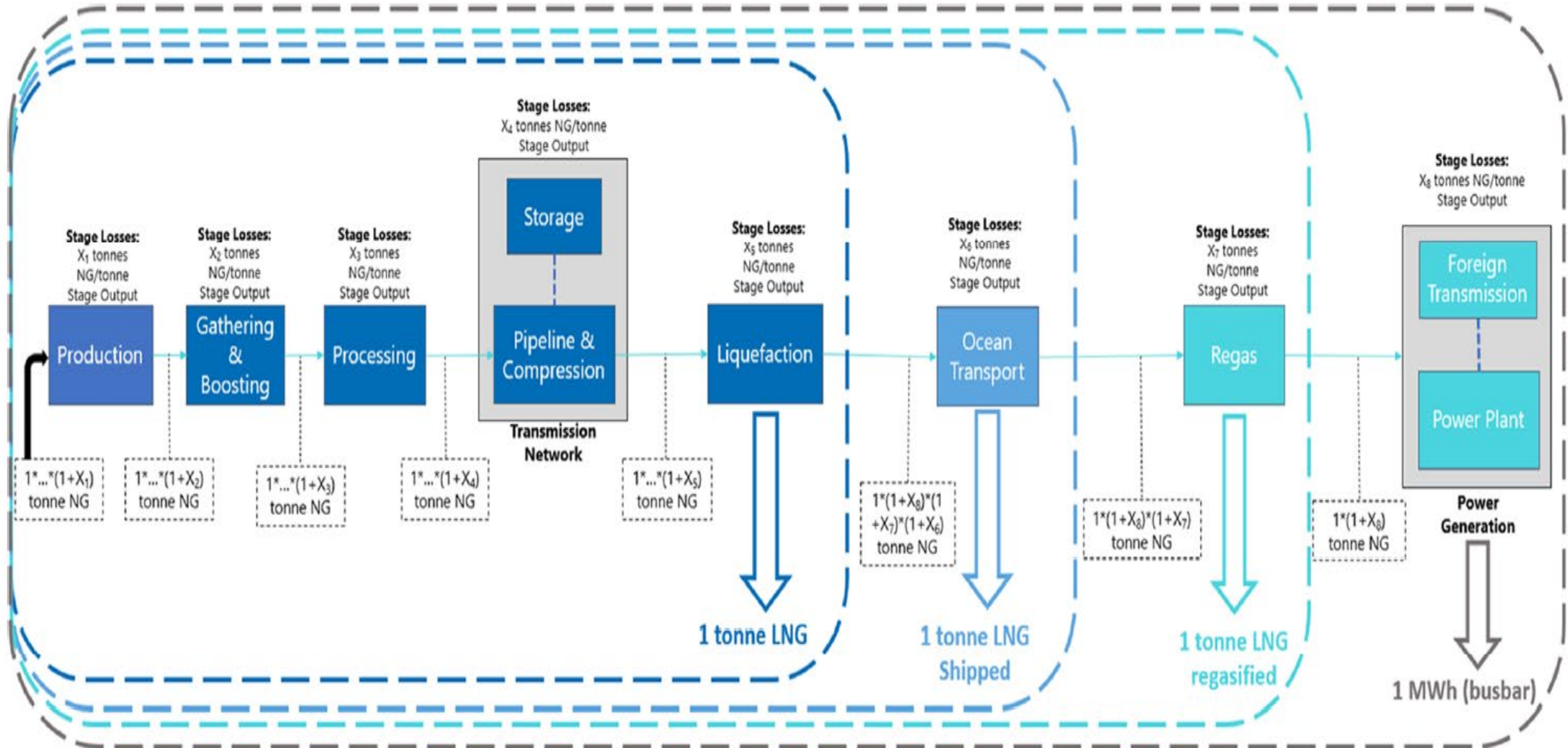


From Clark et al. 2017



From Clark et al. 2017

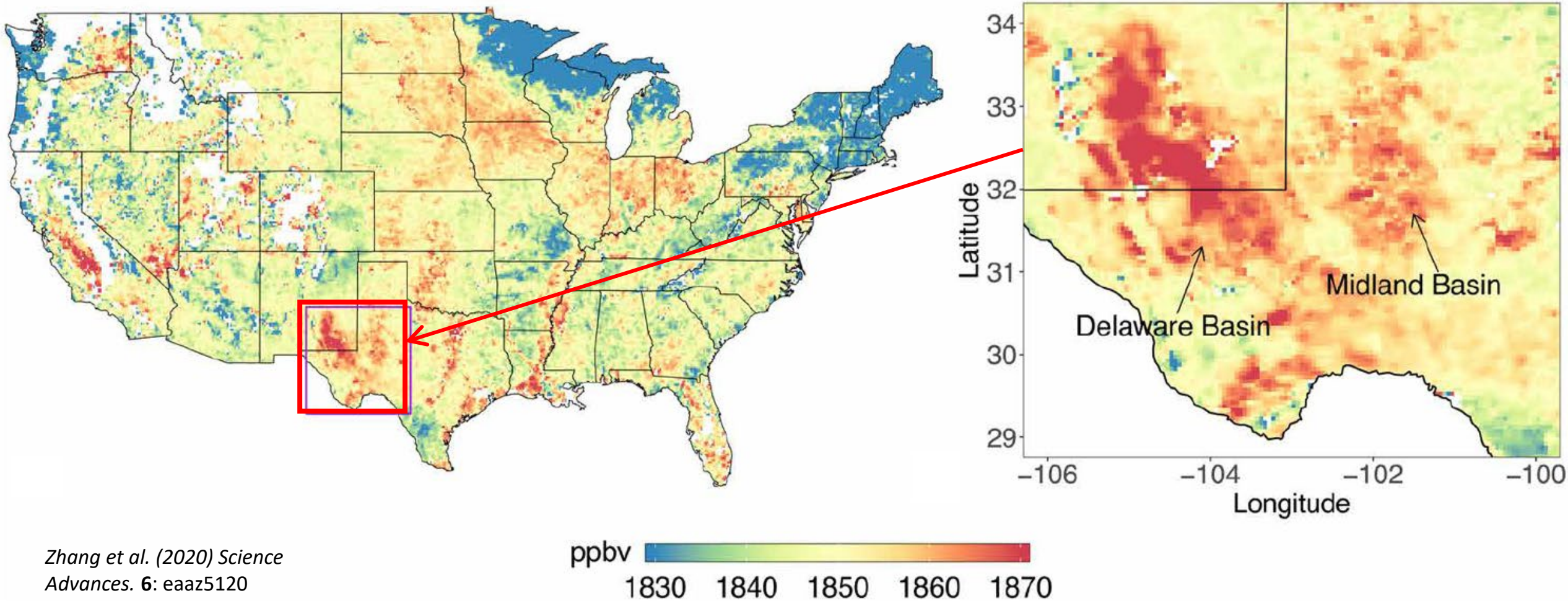
# From Roman-White et al 2021





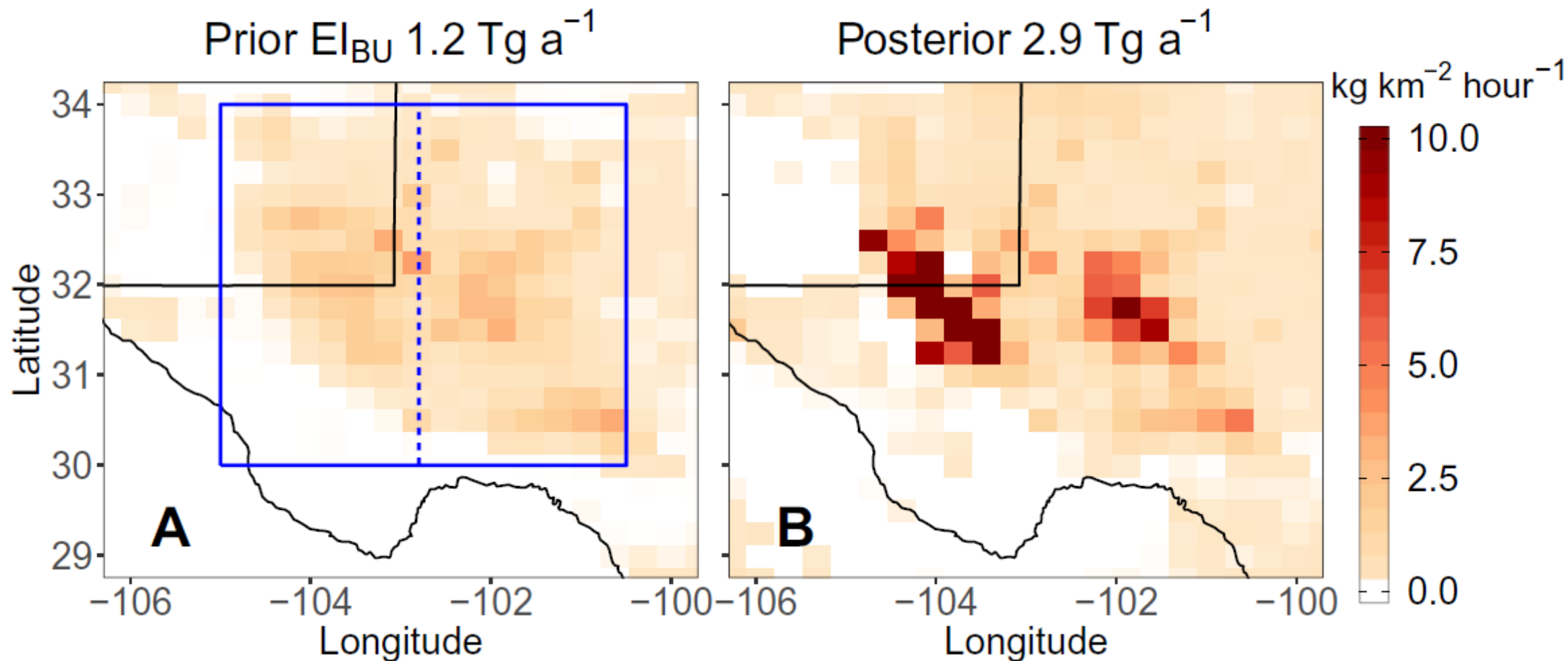
# Recent satellite observations reveal the Permian methane hotspot

TROPOMI methane data averaged from May 2018 – March 2019



Zhang et al. (2020) *Science Advances*. 6: eaaz5120

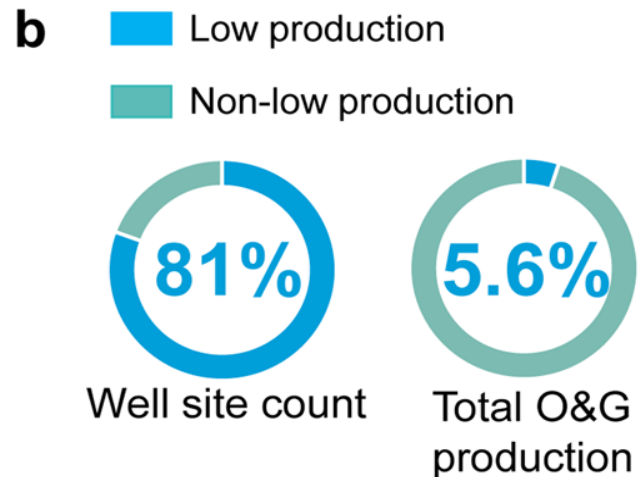
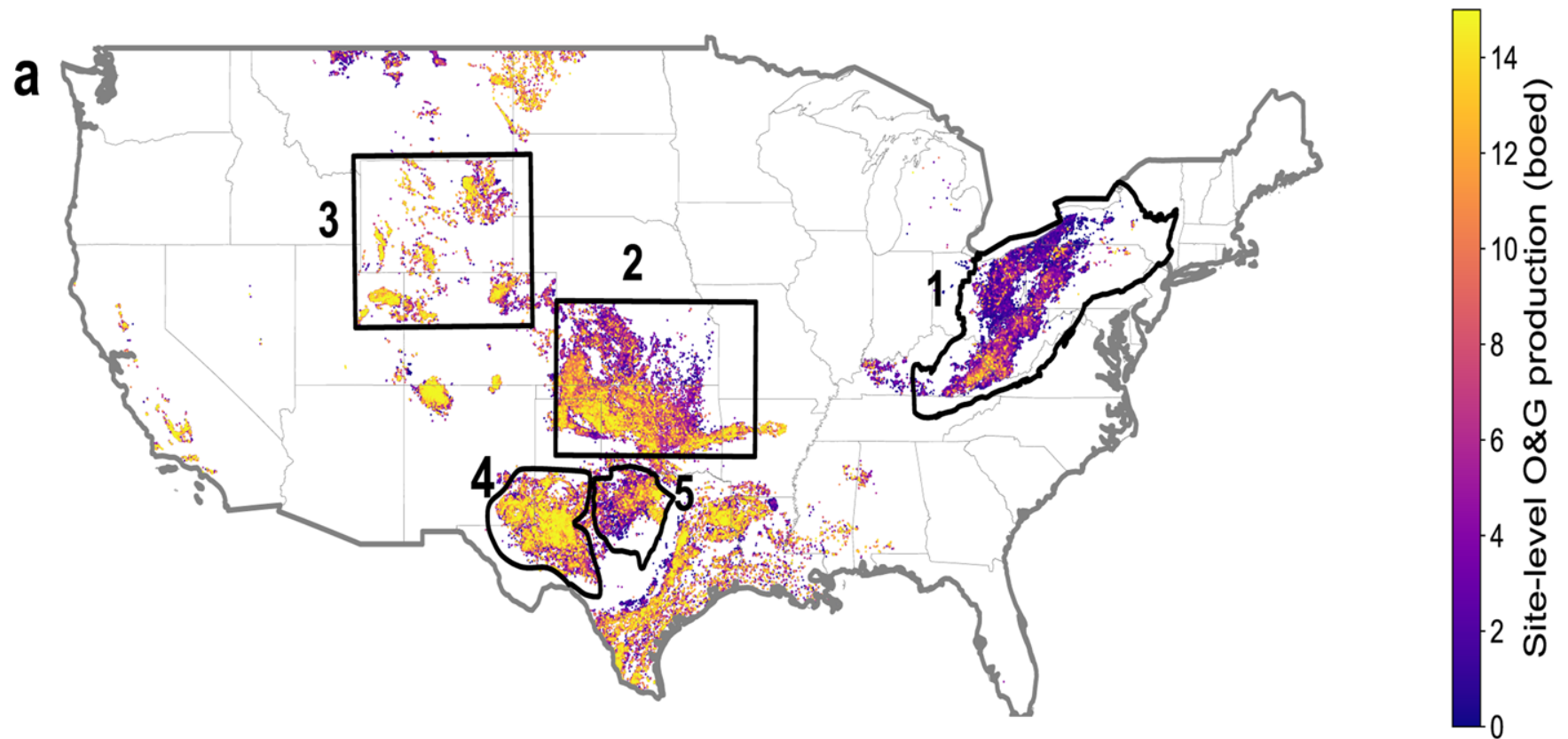
# TROPOMI data reveal highest methane emissions from the Permian Basin ever measured from any U.S. oil and gas basin



# Marginal wells account for most methane emissions

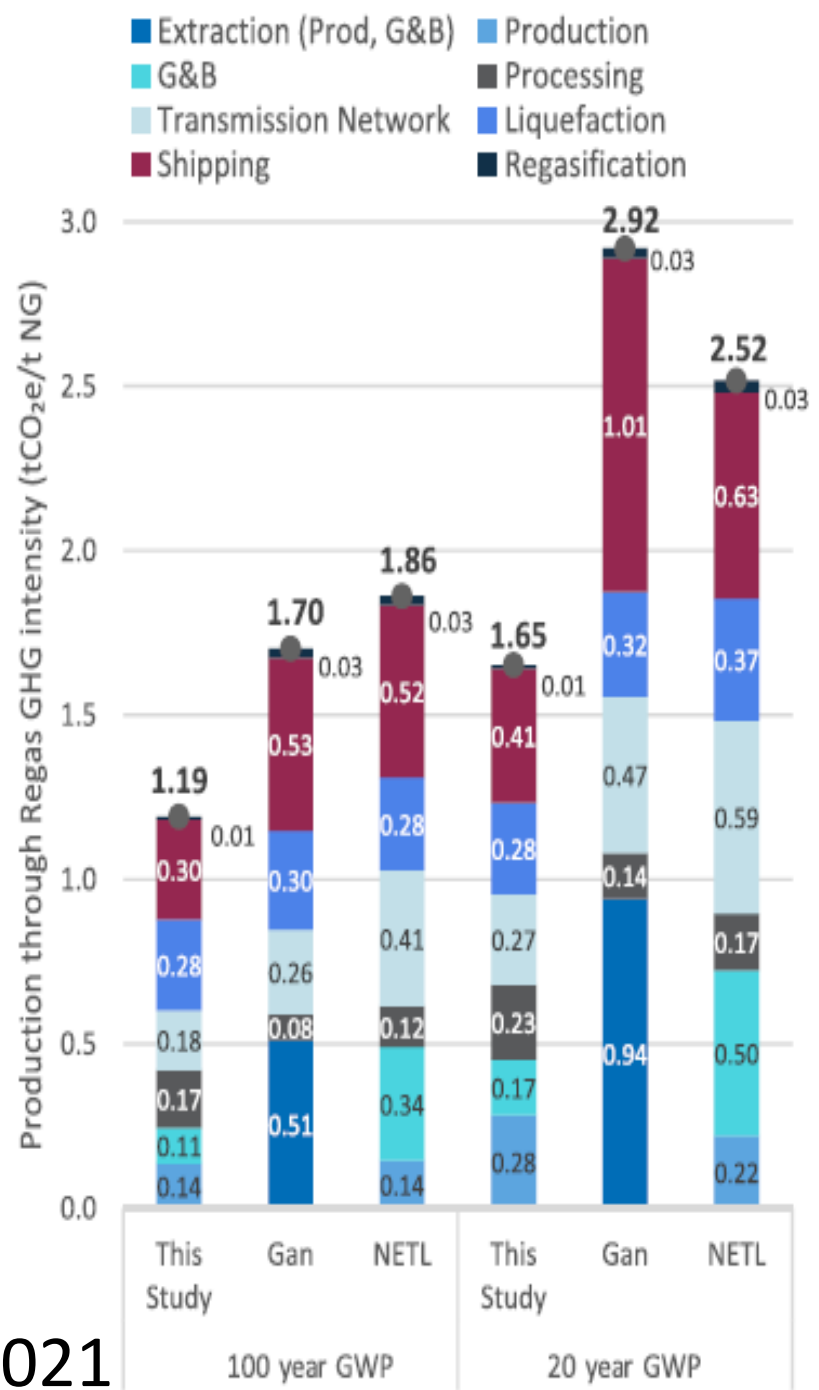
Are they included in value chain accounting?

From Omara et al. 2022



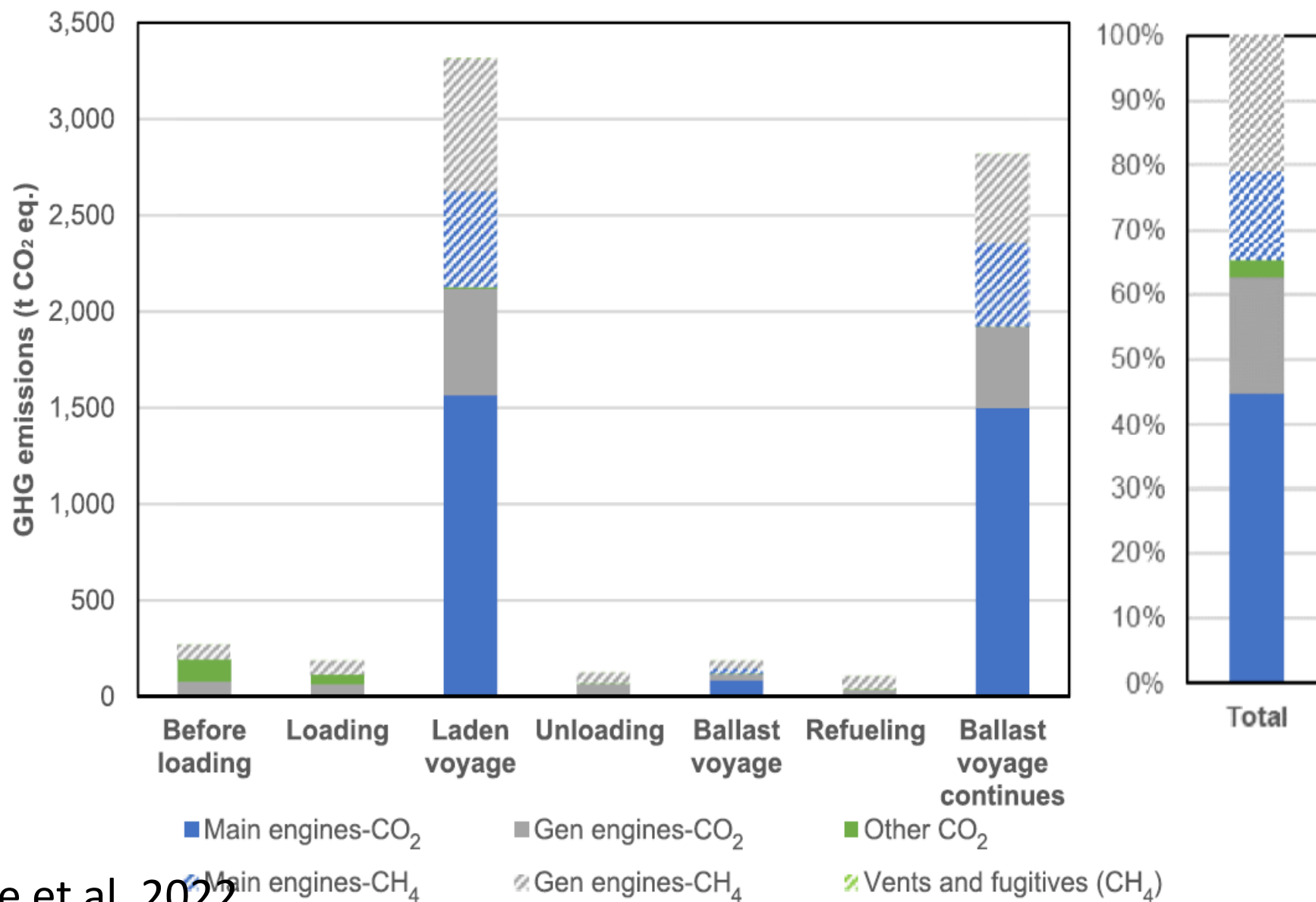
# Metrics Matter

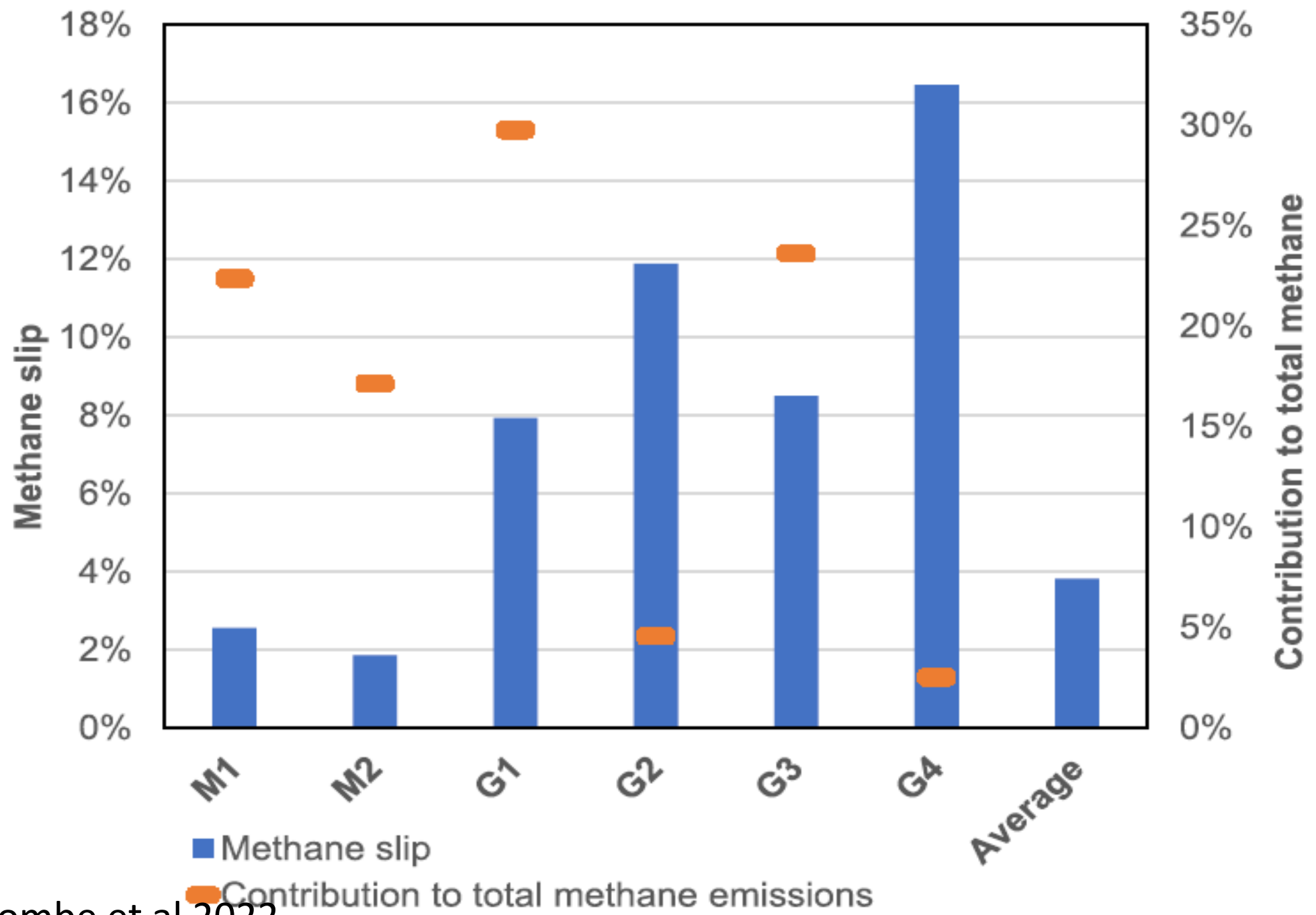
~~CO<sub>2</sub>e~~



From Roman-White et al. 2021

# Need more data





From Balcombe et al 2022

## Bottom Line

- More empirical data is needed
- Metrics need to be selected carefully
- Boundary conditions need to be communicated and selected carefully