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Pathways for Methanol Process Decarbonization

June 2024

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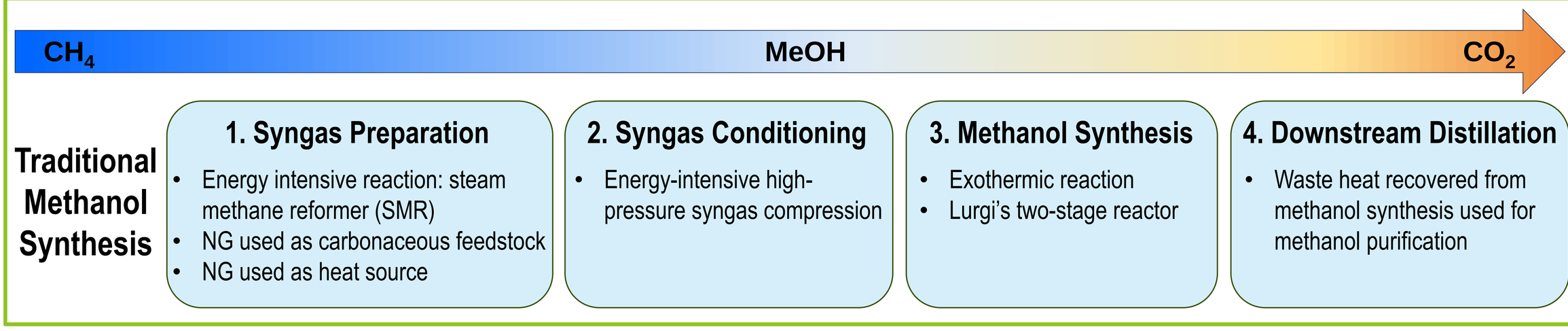
Introduction

The Integrated Energy System (IES) Program at Idaho National Laboratory (INL) is investigating the use of advanced nuclear reactors to displace fossil fuels in methanol production.

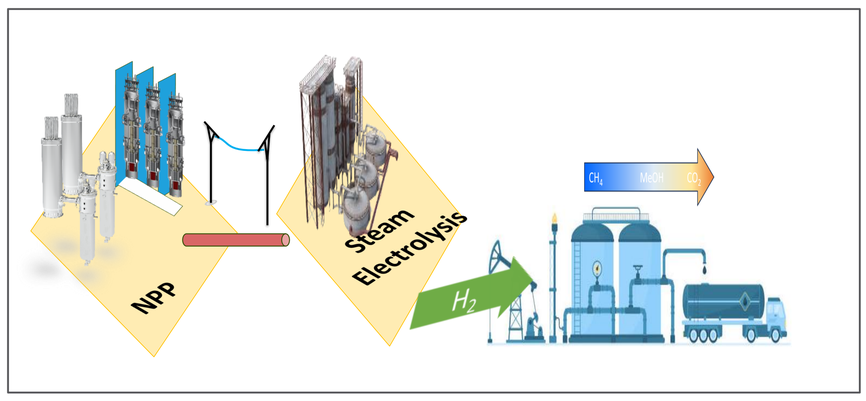
Methanol is considered to be an essential basic building block of chemical products. In addition, methanol is also a core component in the production of synthetic gasoline. Traditionally, natural gas (NG) serves as a critical feedstock and fuel for methanol production, resulting in CO_2 emissions. Replacing NG with clean nuclear energy and exploring alternative pathways for methanol production are critical steps toward decarbonizing methanol production facilities.



Methodology

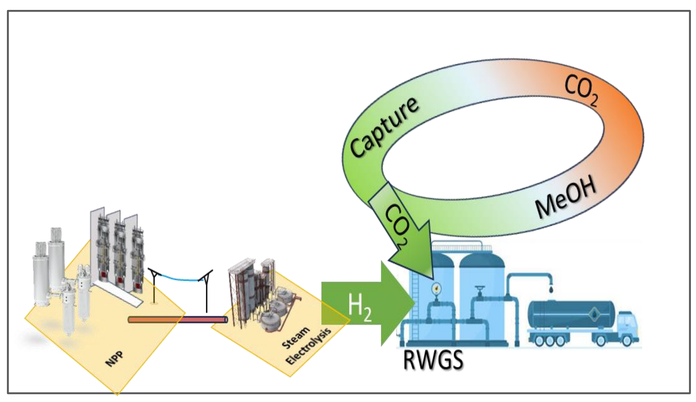
Pathway-1 reduces NG use by replacing the heat source in the SMR with nuclear-generated H_2 for heating purposes.

- Minimal disruption to existing methanol plant
- H_2 is produced via high-temperature steam electrolysis (HTSE)
- 1,300 tpd NG used as fuel is replaced with 500 tpd H_2
- Eliminates all CO_2 emitted from the furnace



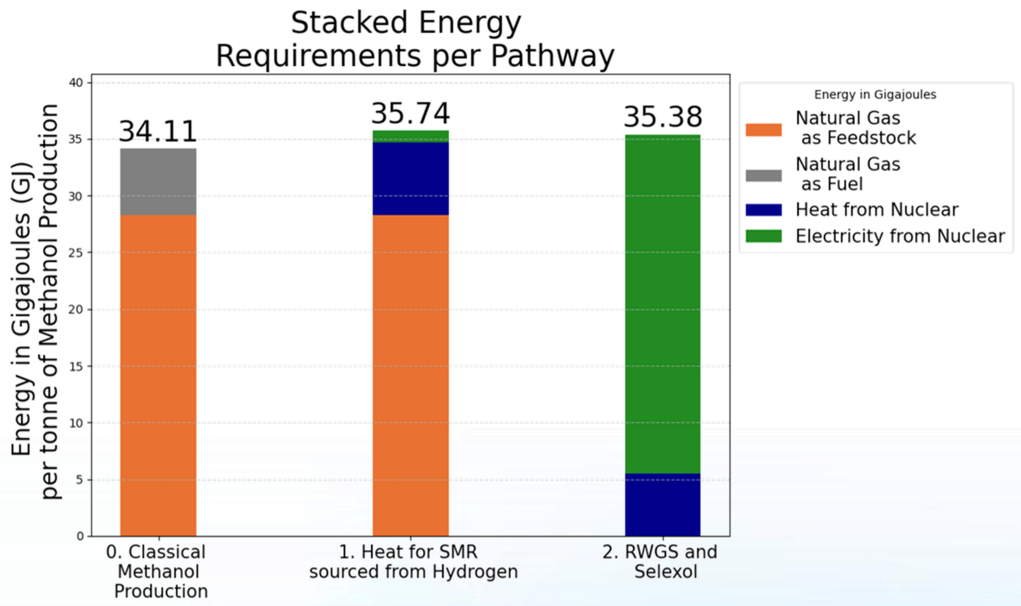
Pathway-2 CO_2 and H_2 with a reverse water gas shift (RWGS) reactor and a Selexol carbon capture process entirely replace traditional syngas preparation via the SMR process.

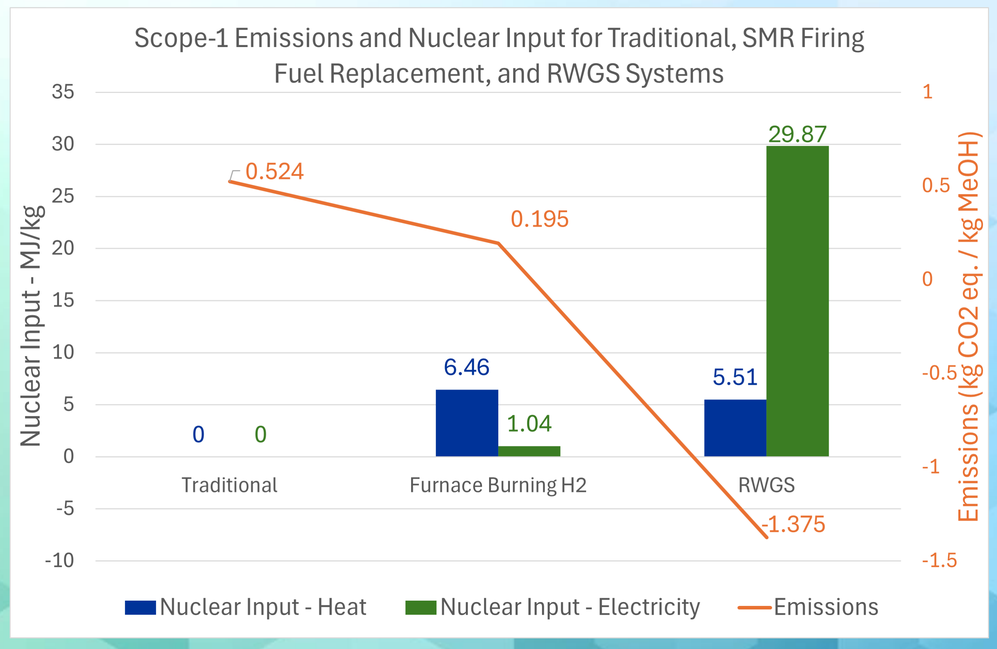
- Uses hydrogen as the heat AND feedstock
- HTSE process to produces H_2
- RWGS process produces CO from an external source of CO_2
- Eliminates all NG use in the methanol process



Results & Conclusions

- **Pathway-1** provides carbon emissions benefits and can be adapted for existing sites.
- **Pathway-2** is a more radical approach, offering huge carbon emissions benefits by consuming CO_2 from an external source, but it will have to be a new methanol production facility.





B. Choi, N. Popli, S. Creasman, R. Yoshiura, J. Yoo, and D. Mikkelson, "Reference Piping and Instrumentation Diagrams for Heat Transport Systems for Methanol Plants," INL/RPT-24-77932, Idaho National Laboratory, Idaho Falls, ID, USA May 2024.

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