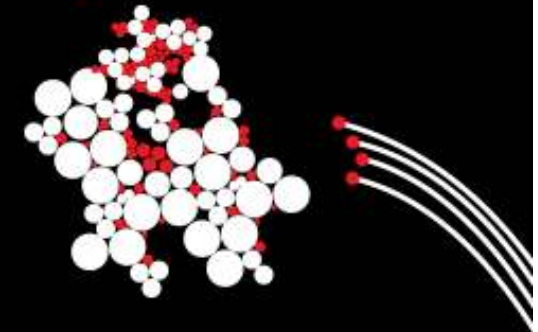
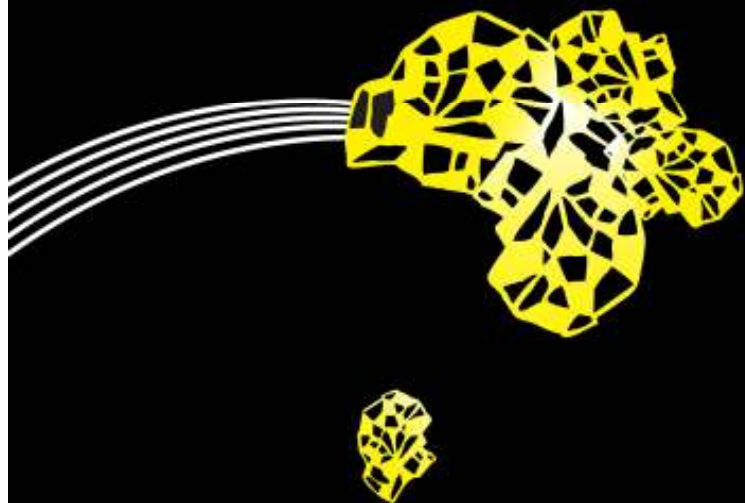


UNIVERSITY OF TWENTE.



# DEVELOPMENT OPTIONS FOR THE DUTCH GAS DISTRIBUTION GRID IN A CHANGING GAS MARKET

TAEDE WEIDENAAR



# INTRODUCTION

## OUTLINE

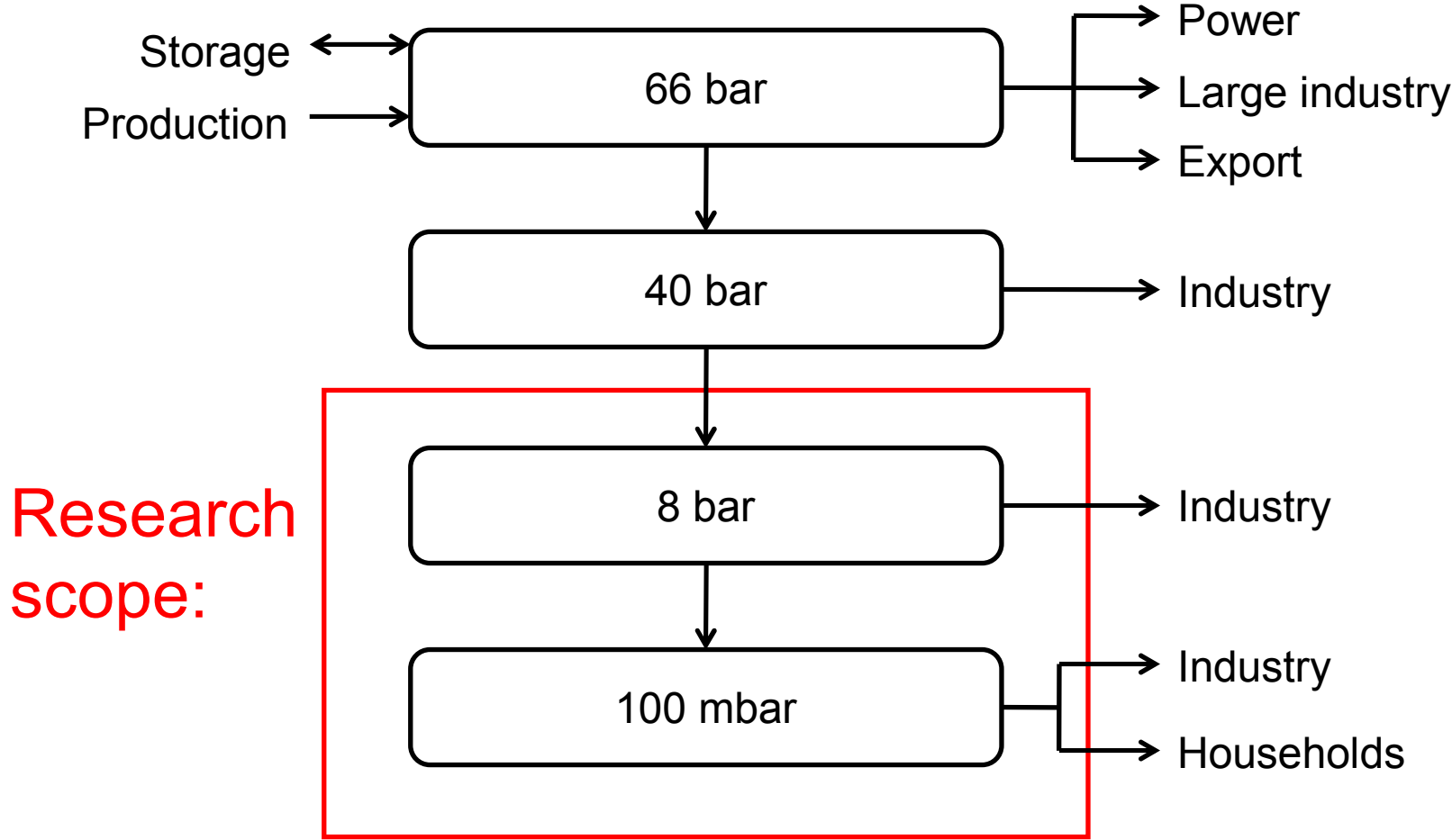
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- Dutch gas grid
- Foreseen changes for the gas grid
- Research question
- Development options gas grid
- Decision Support Tool
- Conclusion
- Questions

# BACKGROUND

## THE DUTCH GAS GRID

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# BACKGROUND

## FORESEEN CHANGES FOR THE GAS DISTRIBUTION GRID

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Green gas share: 0.1%



Green gas share: 12% in 2020

# BACKGROUND

## FORESEEN CHANGES FOR THE GAS DISTRIBUTION GRID

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“Central” gas infeed



“Central” + local gas infeed

# BACKGROUND

## FORESEEN CHANGES FOR THE GAS DISTRIBUTION GRID

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Mono-gas



Multi-gas

# BACKGROUND

## FORESEEN CHANGES FOR THE GAS DISTRIBUTION GRID

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No interaction with other energy grids



Increased interaction with electricity and heat grids

# BACKGROUND

## FORESEEN CHANGES FOR THE GAS DISTRIBUTION GRID

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Passive gas grid



Smart gas grid



# BACKGROUND

## RESEARCH QUESTION

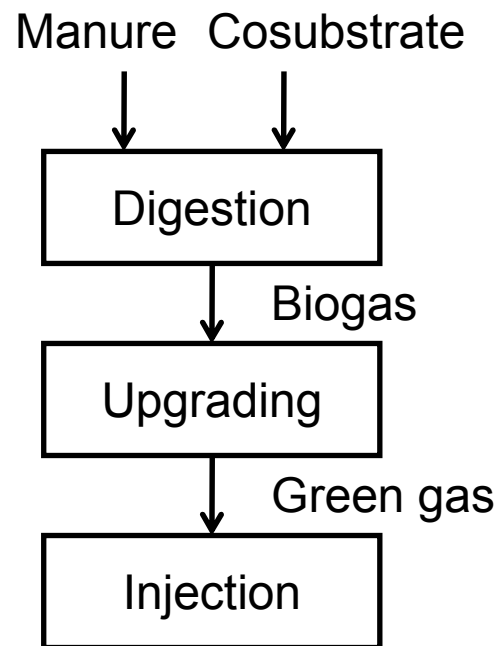
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How can the **system design** and **operational management** of the future gas distribution system in the Netherlands be adapted such that it can cope with the foreseen changes?

# DEVELOPMENT OPTIONS

## GREEN GAS PRODUCTION PROCESS

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# DEVELOPMENT OPTIONS

## GREEN GAS INJECTION CHALLENGES

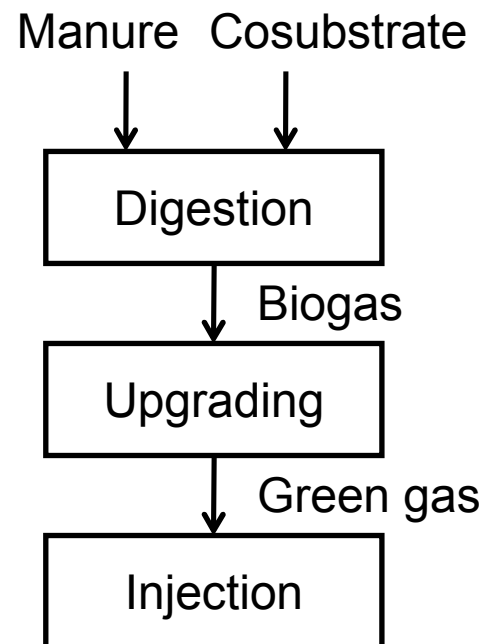
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- Injection in distribution grid
- Balancing problems:
  - Small offtake
  - Seasonal
  - Inflexible production process

# DEVELOPMENT OPTIONS

## DEVELOPMENT OPTIONS FOR GREEN GAS

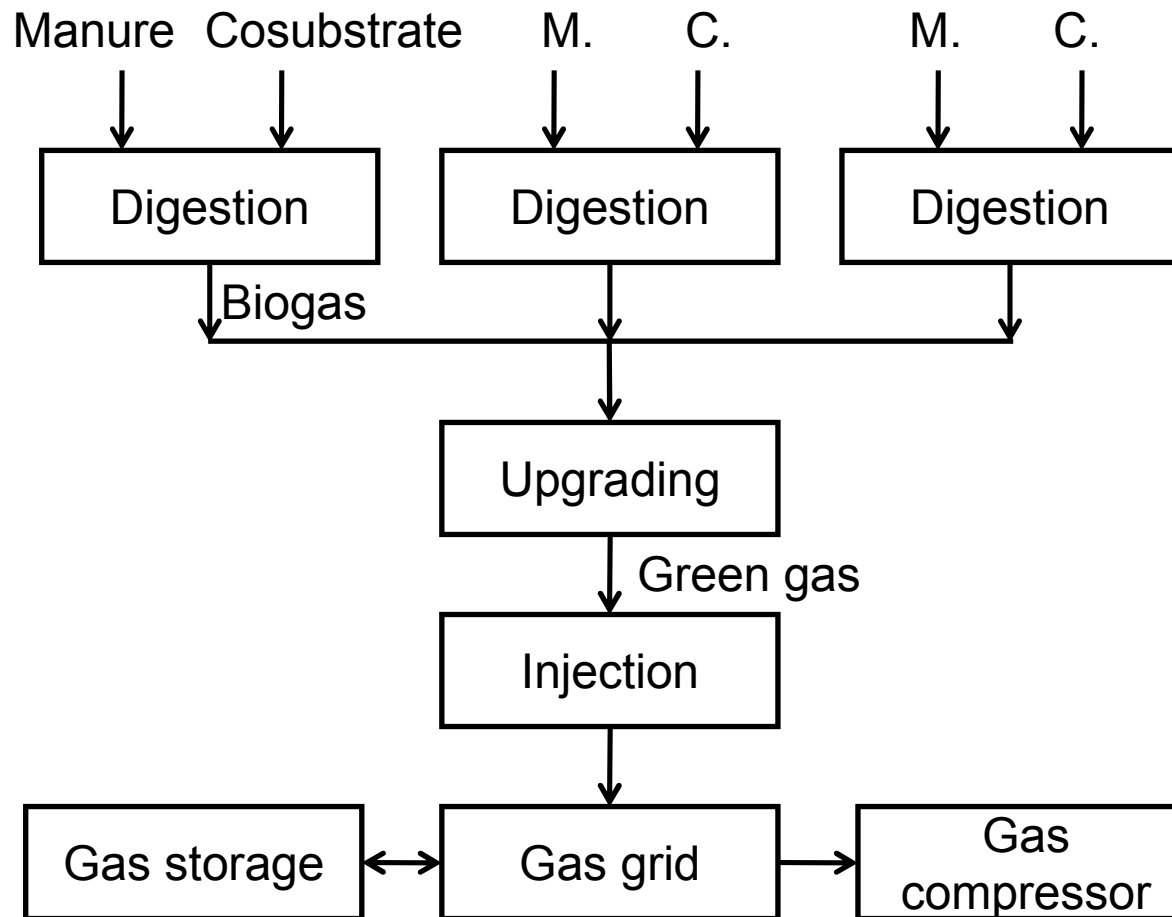
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# DEVELOPMENT OPTIONS

## DEVELOPMENT OPTIONS FOR GREEN GAS

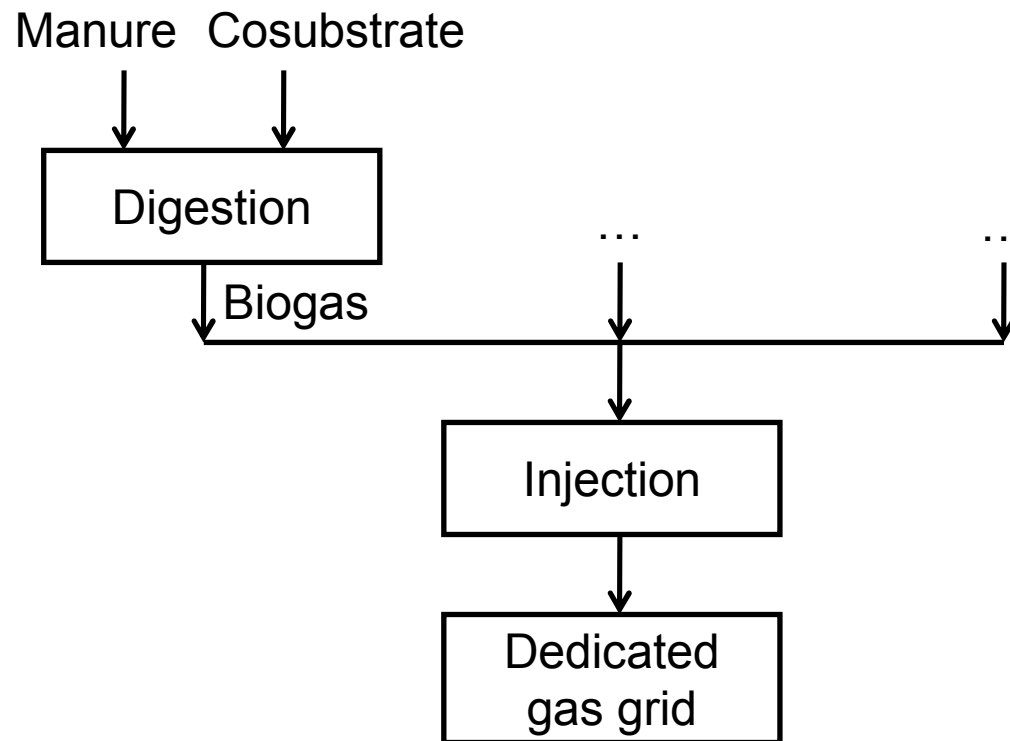
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# DEVELOPMENT OPTIONS

## DEVELOPMENT OPTIONS FOR GREEN GAS

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# **DEVELOPMENT OPTIONS**

DEVELOPMENT OPTIONS FOR GREEN GAS

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**Many development options!**

# DECISION SUPPORT TOOL

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## Need for Decision Support Tool



# DECISION SUPPORT TOOL

## REQUIREMENTS

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- Generation of multiple solutions
- Multiple objectives:
  - CO<sub>2</sub>
  - Costs
  - Energy usage
  - Reliability

# DECISION SUPPORT TOOL

## VARIABLES

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- Addition of gas storage/gas compressor
- Biomass utilization option
- Size and type of digester/upgrading station
- Upgrading of pipeline
- Etcetera

# CONCLUSION

## SUMMARY

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- Gas distribution grid faces changes
- Need for investments
- Need for a Decision Support Tool

# QUESTIONS?

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