A Systematic Mapping of Natural Gas Transportation Systems' Reliability and Risks Analysis

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About the author

Yefeng Liang received his master's degree in computer science from the Stevens Institute of Technology. Now he is a Ph.D. student, his major is system engineering, his research interests are human behaviors research in the digital world and non-engineering risks analysis in industrial systems, and human factors risks analysis in health and commercial systems.

Contributions of our paper:

- *In our paper, we did:*

1. Develop comprehensive analysis on transnational natural gas transportation systems' working process, reliance, stakeholders, reliability and system's operation relationship.

2. Track the system's construction process, and analyze value and risks in the process, try to use reliance relationship to stabilize value and limit risks, then make the system to be reliability

- *Contributions of our study:*

1. Analyze commerical, industrial, and political challenges and risks' influences on the target systems.
2. Provide the graph analysis methods to interpret sub-sections' relationship among complicated systems.
3. Provide the idea to use the inner parts' reliance of comprehensive industrial systems to limit external non-engineering risks.

Research questions

What kinds of factors shape the relationship of each sub-system of the gas transportation system?

What non-engineering challenges and risks we would face when we build transnational gas transportation systems? How to limit these challenges and risks?

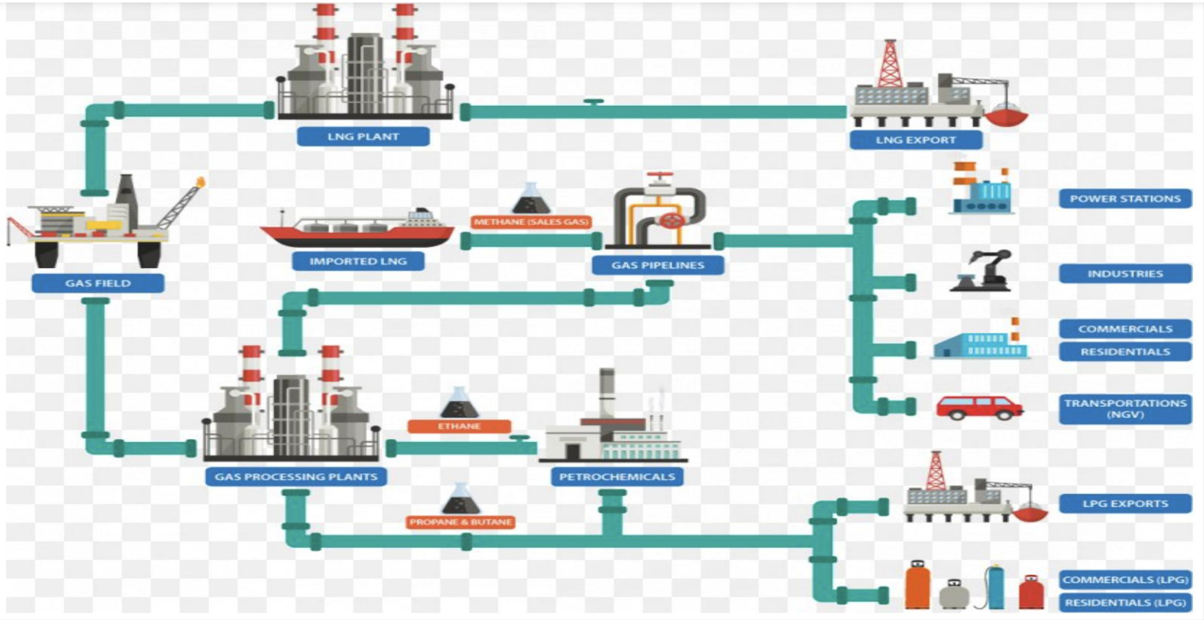
How do we list and interprete those relationship and risks?

Research methods

Methods:

- Stakeholder analysis
- Casual-loop analysis
- System reliance analysis
- Shaping forces analysis

Malaysia Peninsula Gas Utilisation Natural Gas Processing Pipeline Transportation



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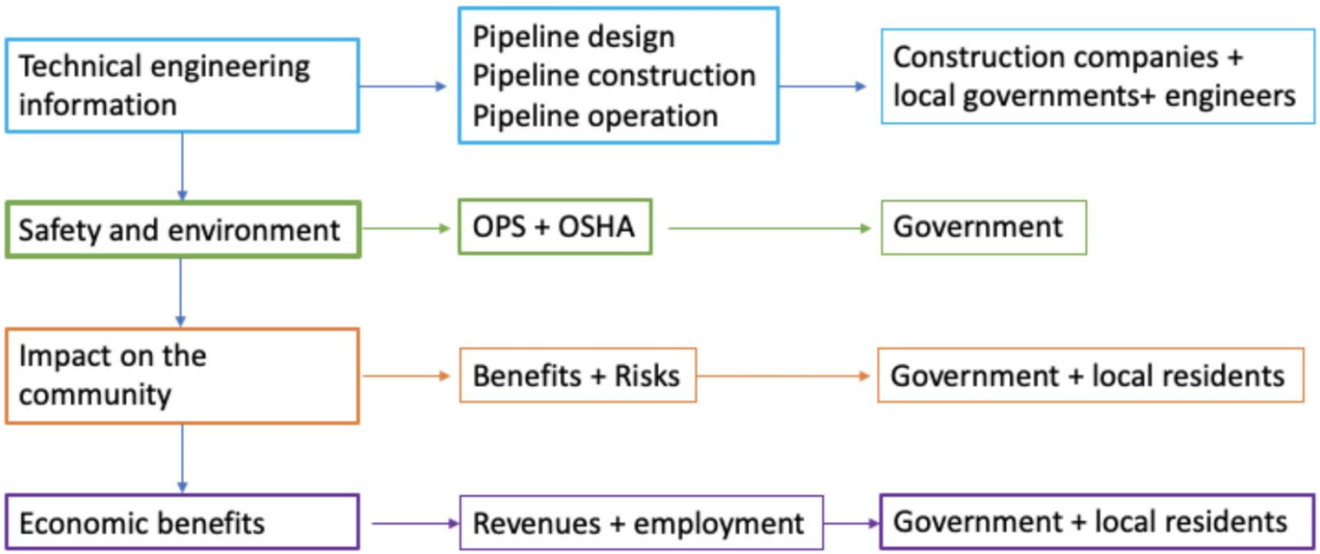
- Complicated energy products.
- Complicated energy transportations.
- Complicated stakeholders.

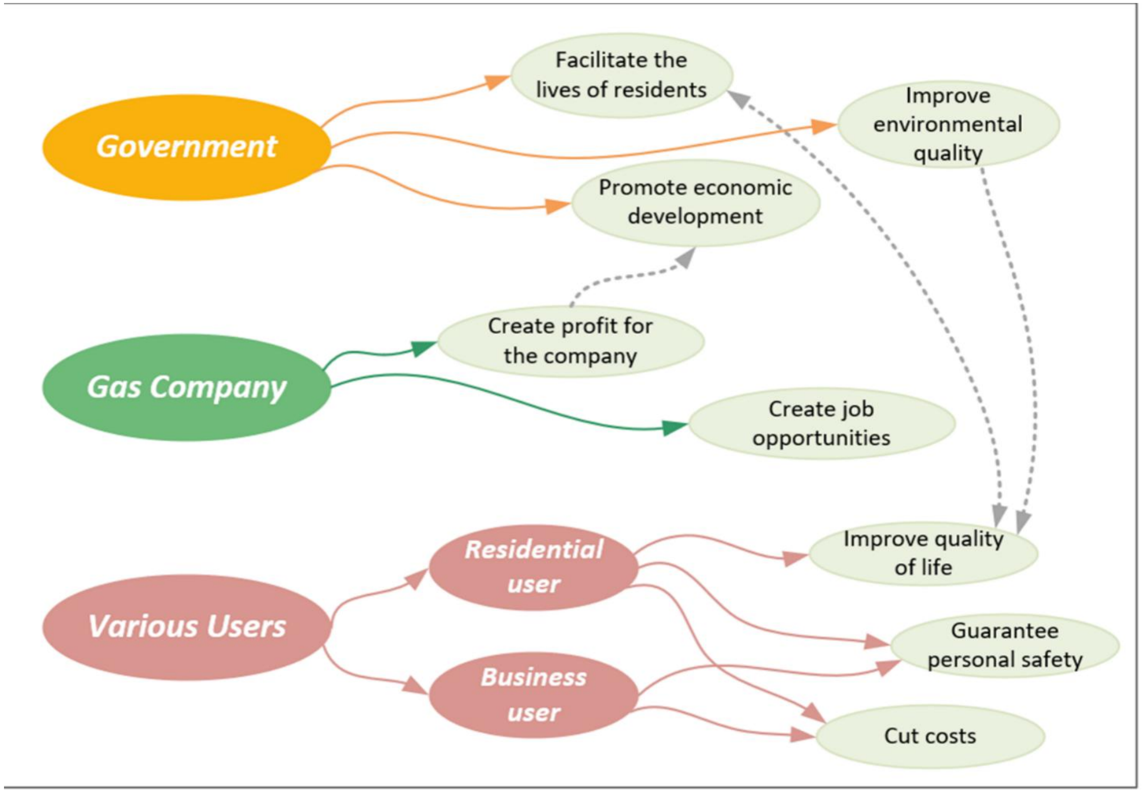
The relationship before the system' constructions

Because of the complications of the system, before starting the construction, we may have a prior map of the system's working process and stakeholders.



Value adding process when the system is working

When the system is working, we expect that the current system could add more value for providers(Gas company), controllers(Government), and consumers(Gas consumers).

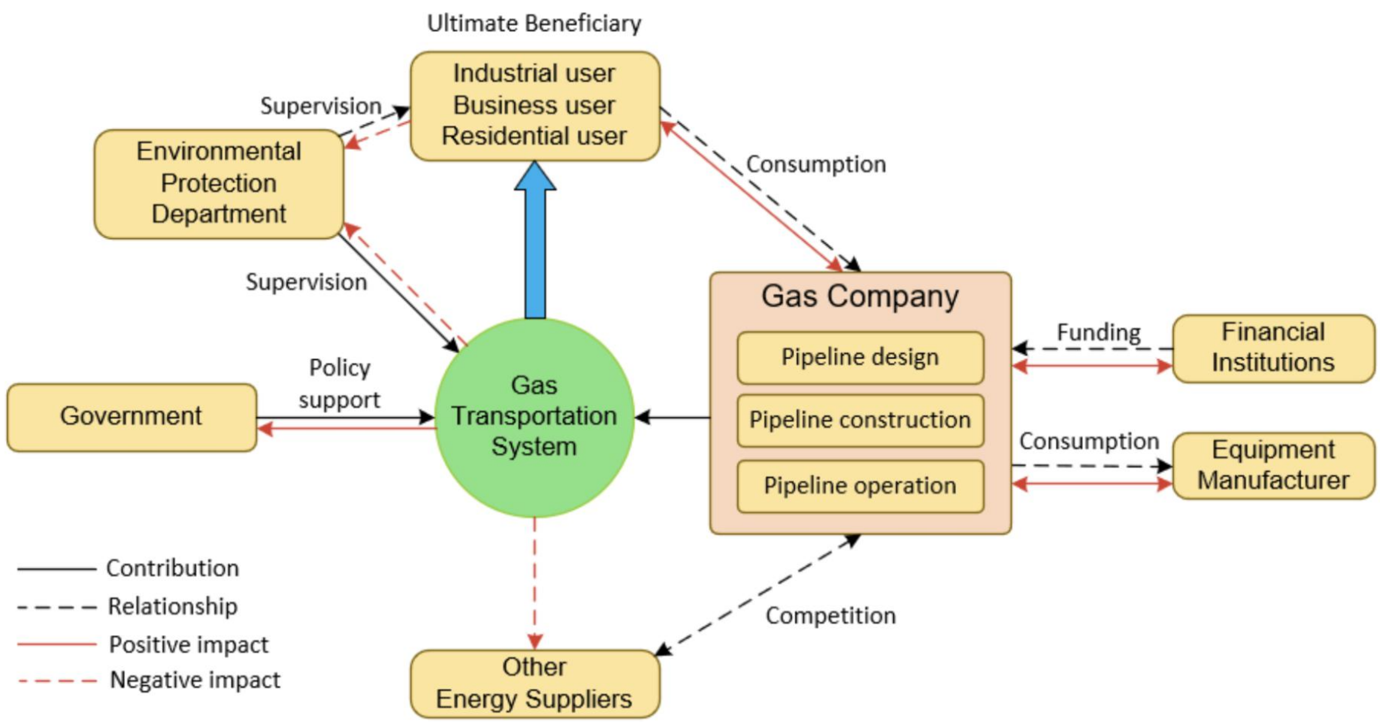


However, after finishing the system constructions……

- Different stakeholders will face their own risks in long-term reliance of the gas transportation system.
- The external uncertainty and objective non-engineering relationship could also become significant factors to bring challenges and risks for the current gas transportation system.

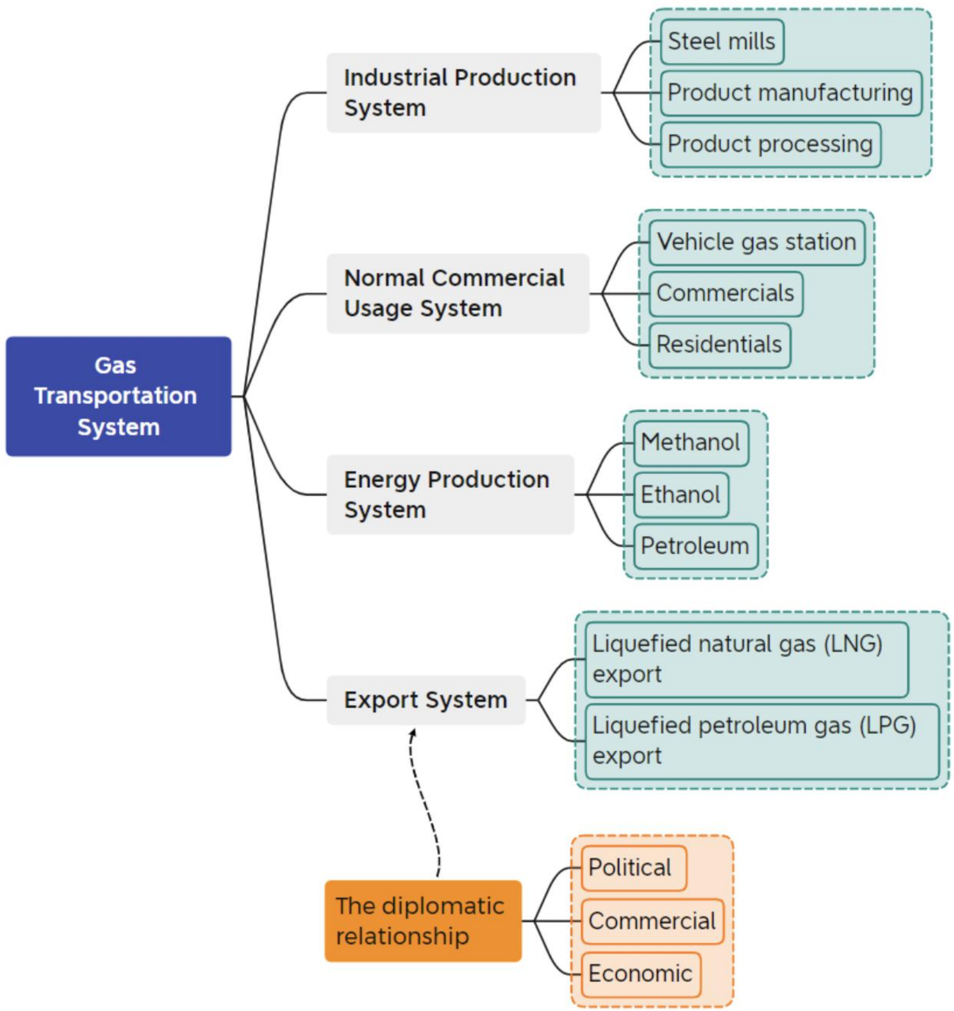
Stakeholders' relationship

Interest Map of Stakeholders.



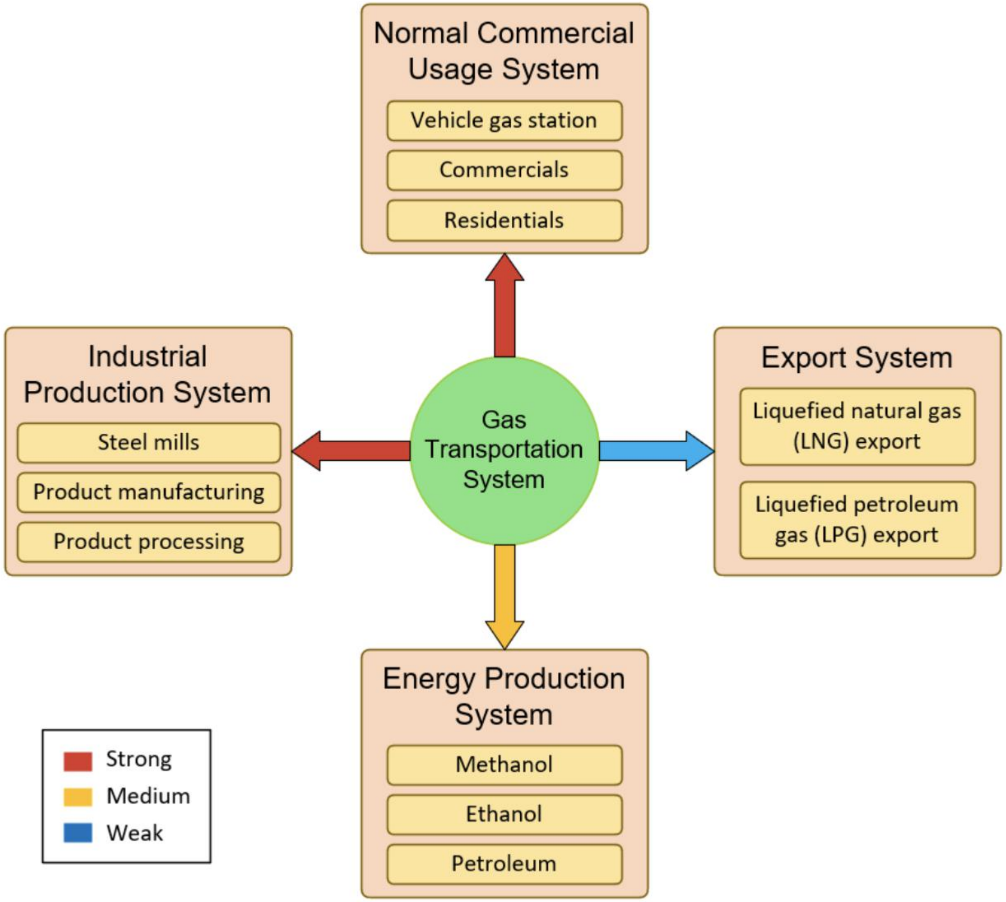
Shaping Forces

Diplomatic relationship: Shaping export systems, shaped by export systems.



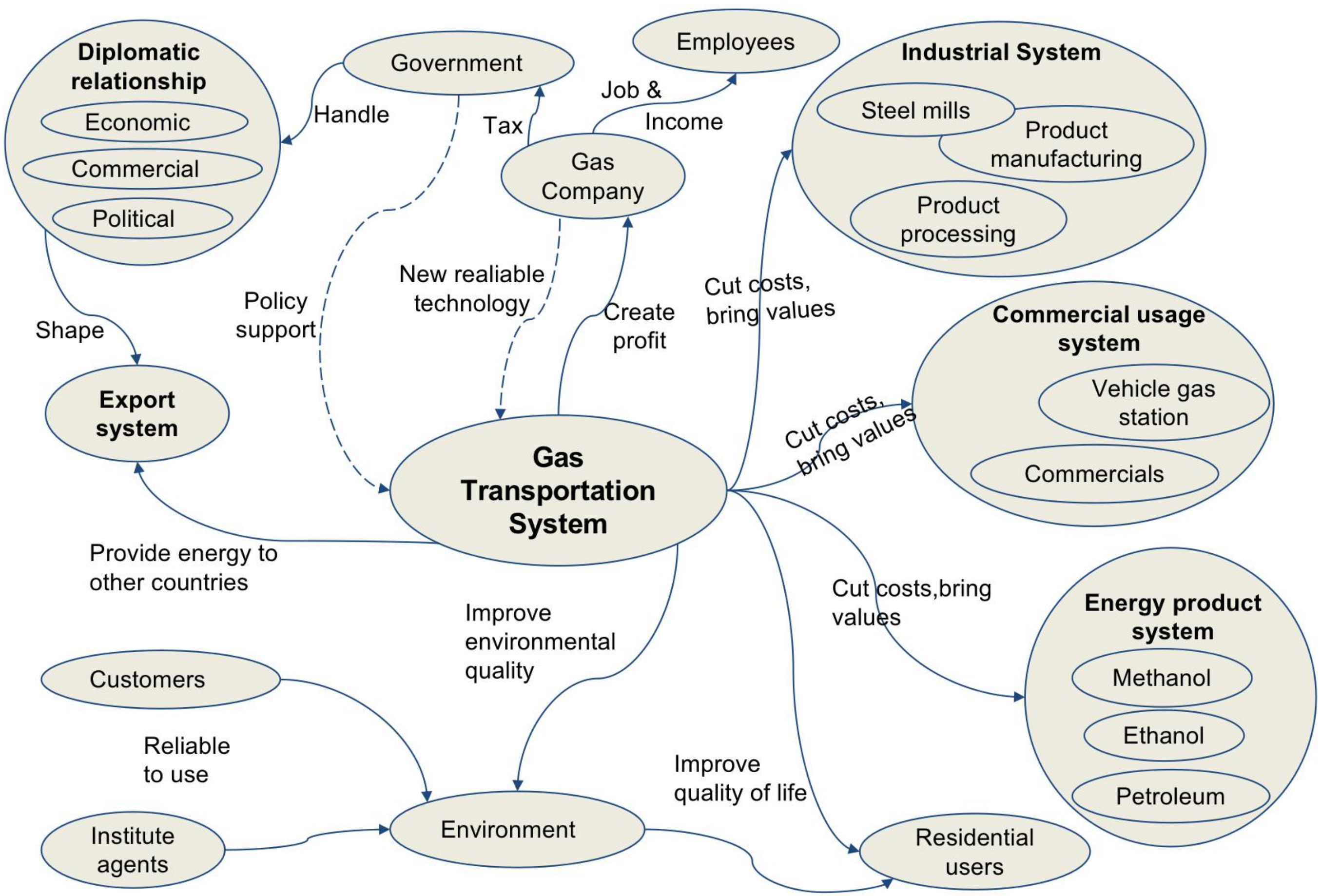
Reliance

Reliance between gas transportation systems' sub-systems.



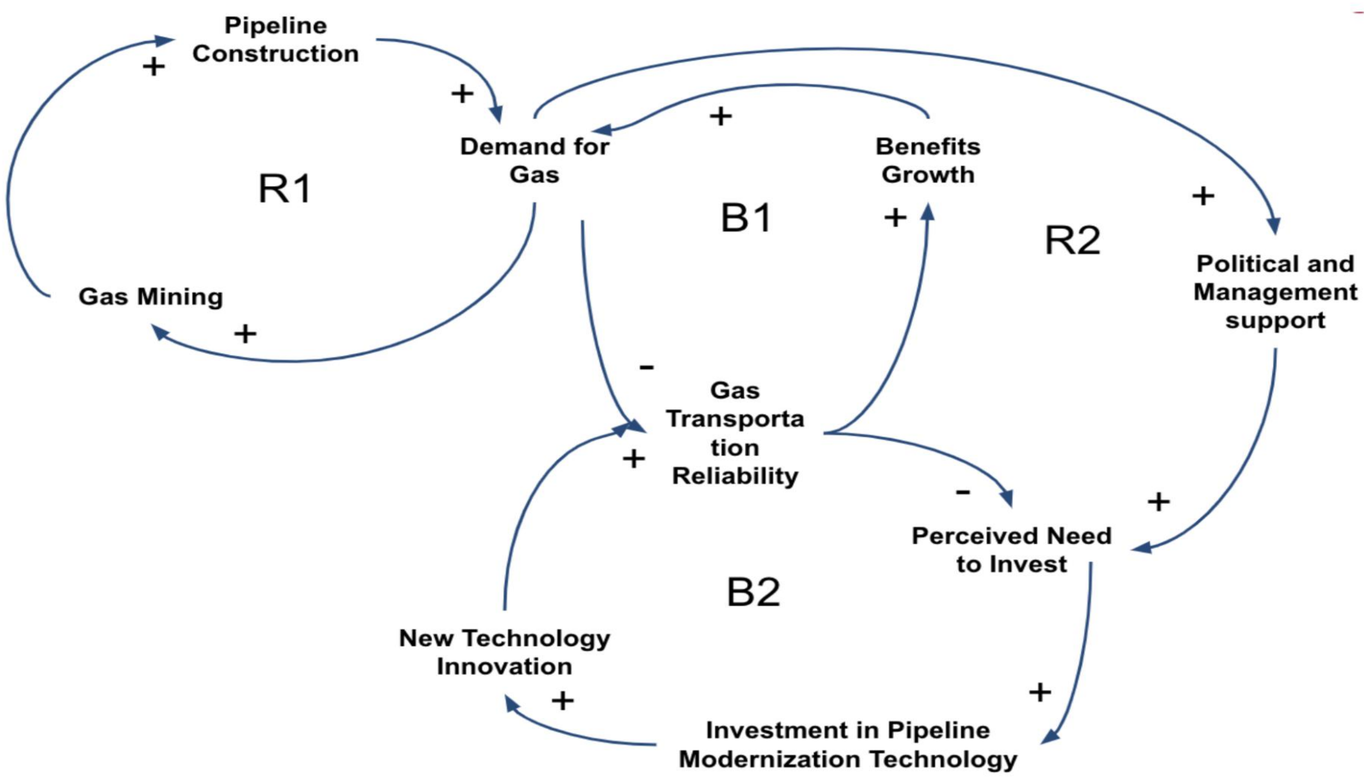
Build reliable gas transportation system

We can use reliance relationship in gas transportation systems to limit these non-engineering risks' effects.



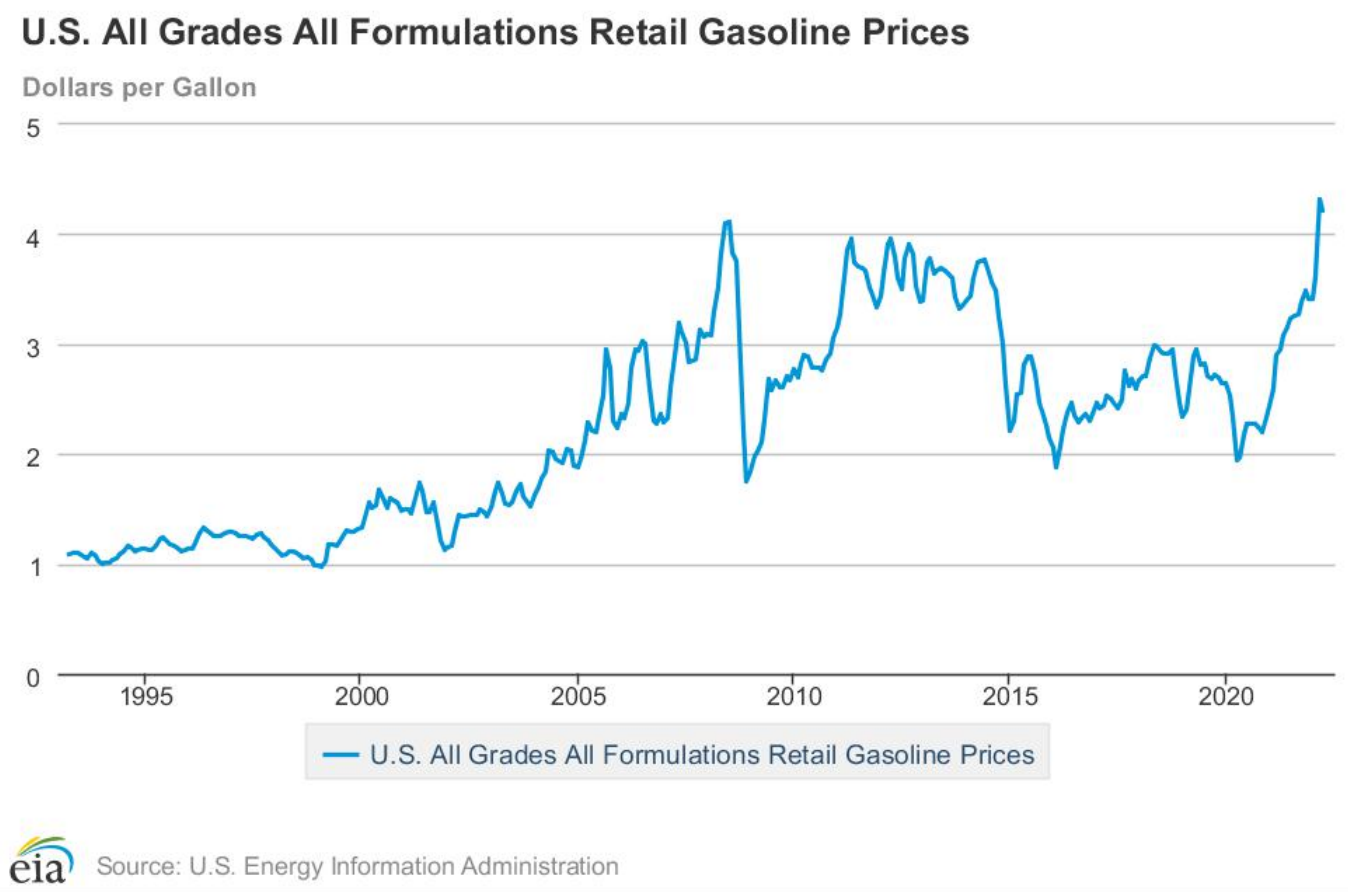
Strengthen the reliable gas transportation system

Casual Loop analysis for gas providers, the reinforcement (R) and balance forces' explanations (B), positive (+) and negative consequent effects (-) among these factors.



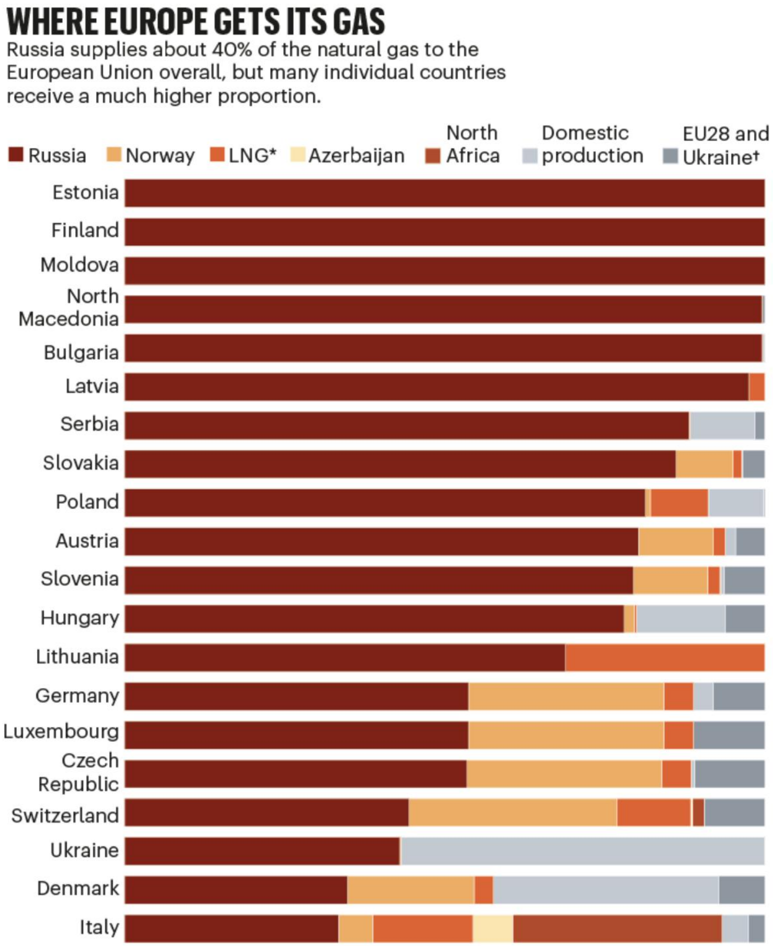
Discussions --- political risks for the price

Gasoline prices' fluctuations in the US.



Discussions --- high reliance risks for the price

Most of EU countries have high reliance for the transnational energy transportation.



- The heavy reliance on energy transportation systems increases the non-engineering risks, such as monopoly, and significant price fluctuation.
- The related stakeholders need a third party organization to stabilize the international energy supply and price could make decisions to avoid energy price's huge fluctuations.
- Build reliance relationship in different consumers and sub-systems of the gas transportation system could lower these risks.

Conclusions

- **Stakeholders of natural gas transportation systems rely heavily on each other, and the systems. The benefits groups may face more specific risks when making the trade-off between system construction and environment, customers living experience and gas benefits. Those considerations bring more implementation uncertainty and risks.**

- **Concerns from those challenges and issues need the natural gas transportation system to be built long-term reliability and durable.**

- **Try to be aware of risks and avoid related severe consequences in early gas transportation system-building stage could lead the whole system become more stable and robust, and the system could benefit more stakeholders in a very long term.**

Conclusions

- **By building and strengthening the reliability relationship between different sub-systems, stakeholders, and environments, the target system could lower the risks.**

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Limitations and Future work

- *We need more reality successful cases to support our ideas.*
- *We will try to explore more probabilities that using systems' links with the environment and the reliance among systems' sub-working units, to build and strength the target systems to limit the non-engineering external risks.*

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