

# **Risk Management in the Energy Industry**

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**Unit 2: Cascading Risks -  
Workflows for Risks**



# Unit 2: Cascading Risks: Workflows for Risks

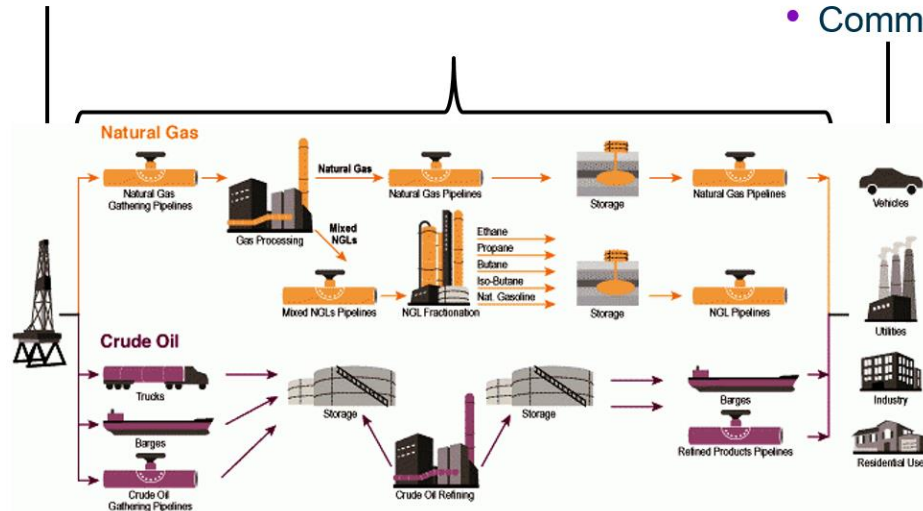
## Unit Learning Objectives

- ◆ Determine the data you need to understand systemic risks
- ◆ Identify the relationships that lead to cascading risks
- ◆ Discuss ways to develop workflows of flows of risks
- ◆ Identify the locations most likely to trigger cascading failures
- ◆ Identify the types of risks associated with the failures
- ◆ Describe methods of analyzing cascading risks

# Map Your Processes: Start with the Big Picture

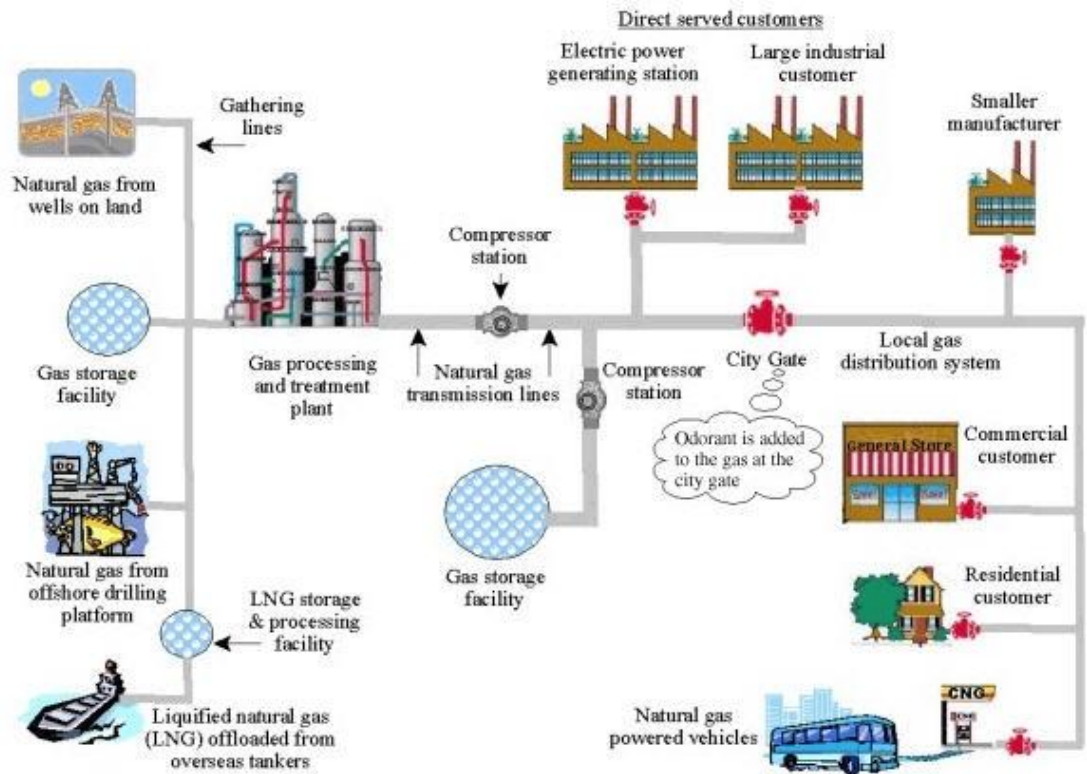
- ◆ To begin, you will need to map the process, procedure, or supply chain to identify the larger flow areas, along with the areas which can encounter problems.

- Upstream
  - Drilling
  - Production
- Midstream
  - Transportation
  - Treatment
- Downstream
  - Industrial
  - Residential
  - Commercial



# Example: Natural Gas Pipelines

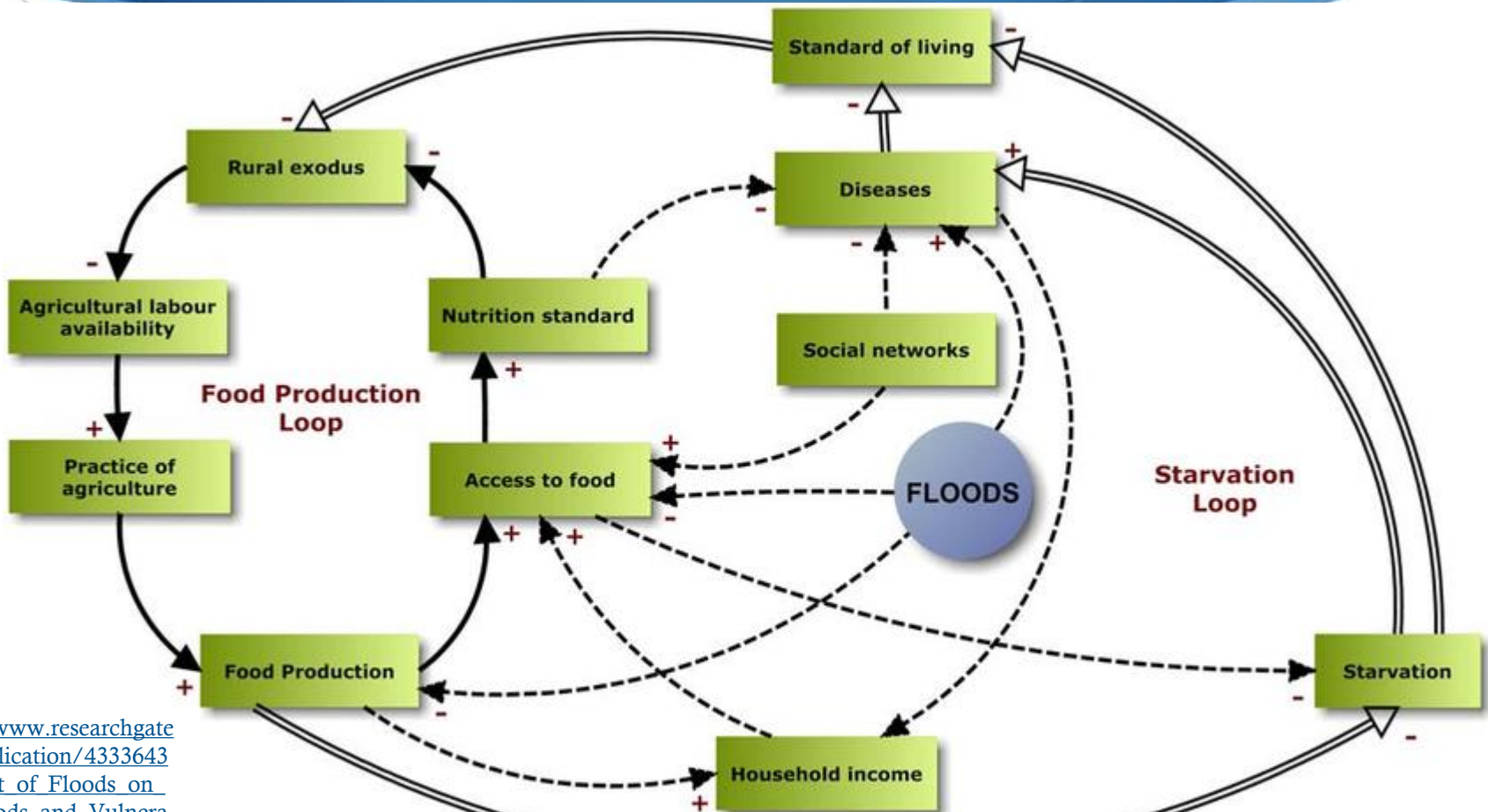
- How does a failure in one part of the distribution system affect the other parts?
- Where, how, when can the elements be isolated from each other in the case of an accident?



# Natural Disaster Preparedness: Risk in Critical Infrastructures

- ◆ Start with a linear flow
- ◆ Identify the main components
- ◆ Then create a web or mind map to show the more complex relationships
- ◆ “Risk relationships and cascading relationships in critical infrastructures”
- ◆ <https://www.preventionweb.net/english/hyogo/gar/2015/en/bgdocs/McGee%20et%20al.,%202014.pdf>

# Causal Loop Diagram: Example: Floods and Food Security

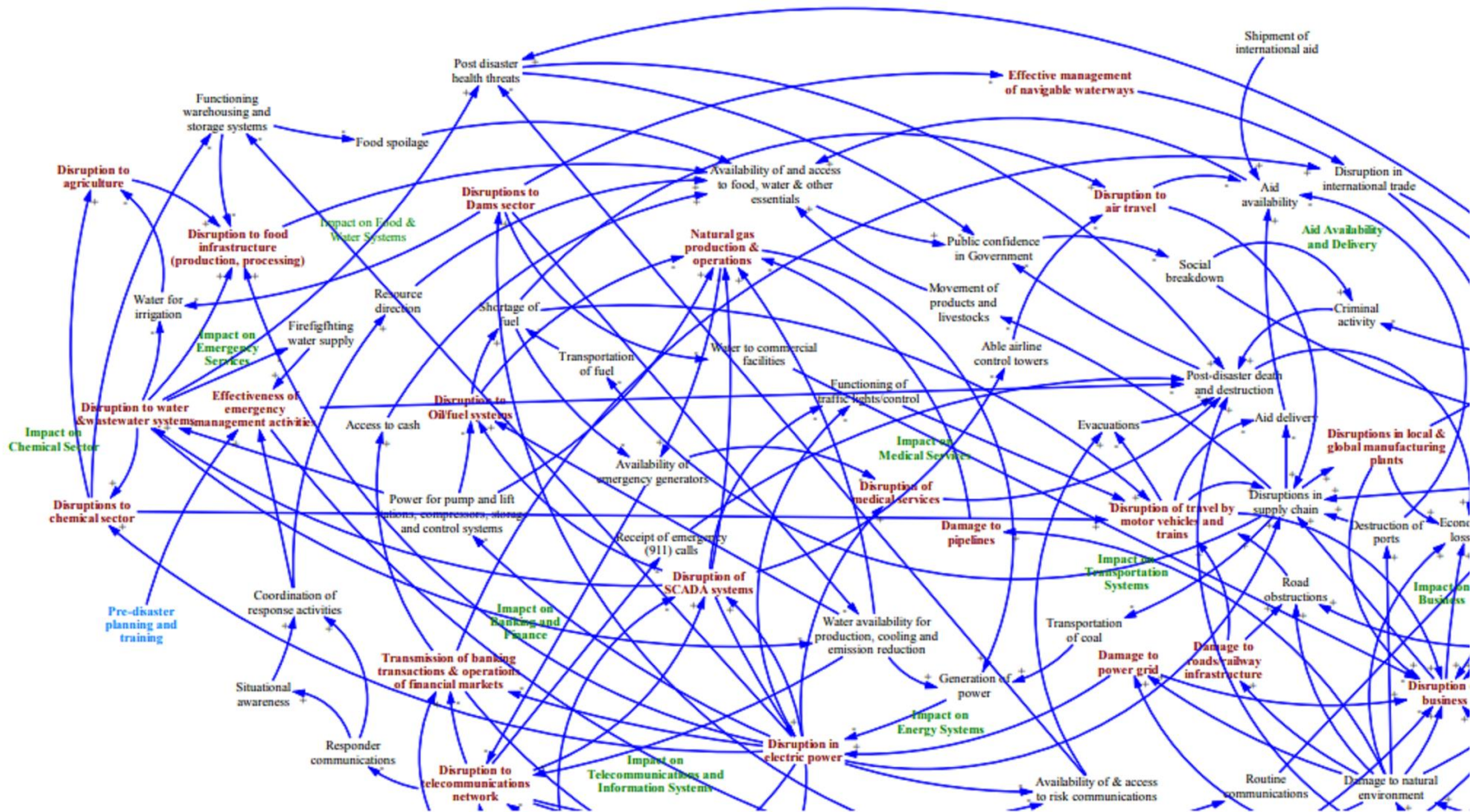


[https://www.researchgate.net/publication/43336432\\_Impact\\_of\\_Floods\\_on\\_Livelihoods\\_and\\_Vulnerability\\_of\\_Natural\\_Resource\\_Dependent\\_Communities\\_in\\_Northern\\_Ghana](https://www.researchgate.net/publication/43336432_Impact_of_Floods_on_Livelihoods_and_Vulnerability_of_Natural_Resource_Dependent_Communities_in_Northern_Ghana)

# Causal Loop Diagram: Critical Infrastructure-Induced Cascading Effects in Disasters

- ◆ *The loop diagram can become very complex –*
- ◆ Use different colors to indicate the type of infrastructure, location or facility
- ◆ Draw arrows to show the impact on all the different facilities, infrastructure, people, etc.
- ◆ Include ultimate consequences

# Causal Loop Diagram: Critical Infrastructure-Induced Cascading Effects in Disasters



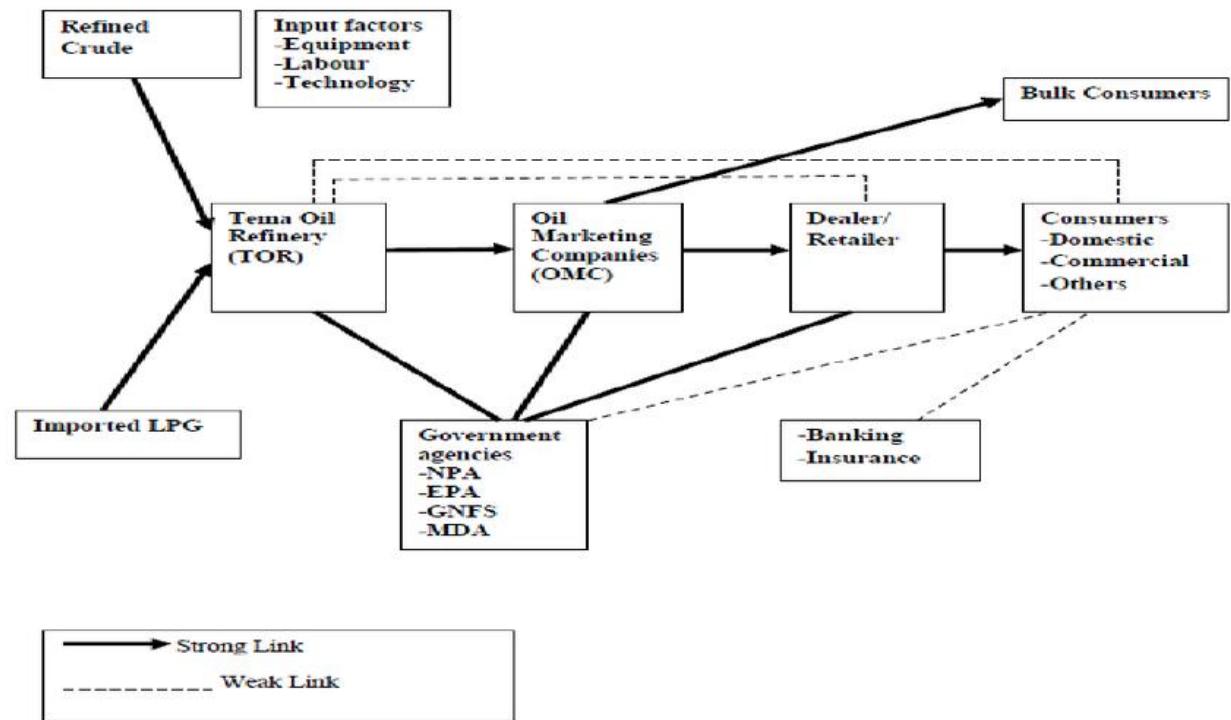


# Evaluating Likely Rupture Points

- ◆ Mapping Supply Chain Constraints in LPG
- ◆ Potential weak links
- ◆ Analysis of Liquefied Petroleum Gas (LPG) Shortage in Ghana: Case of the Ashanti Region
- ◆ <https://www.researchgate.net/publication/267245130> Analysis of Liquefied Petroleum Gas LPG Shortage in Ghana A Case of the Ashanti Region
- ◆ Illustration: [https://www.researchgate.net/figure/Structure-and-mapping-of-LPG-supply-chain\\_fig3\\_267245130](https://www.researchgate.net/figure/Structure-and-mapping-of-LPG-supply-chain_fig3_267245130)

# LNG Supply Chain: Weak and Strong Links

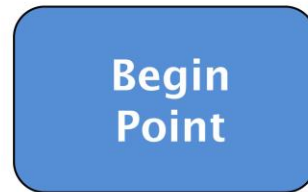
- Identify the strong links
- Identify the weak links
- What can be done?



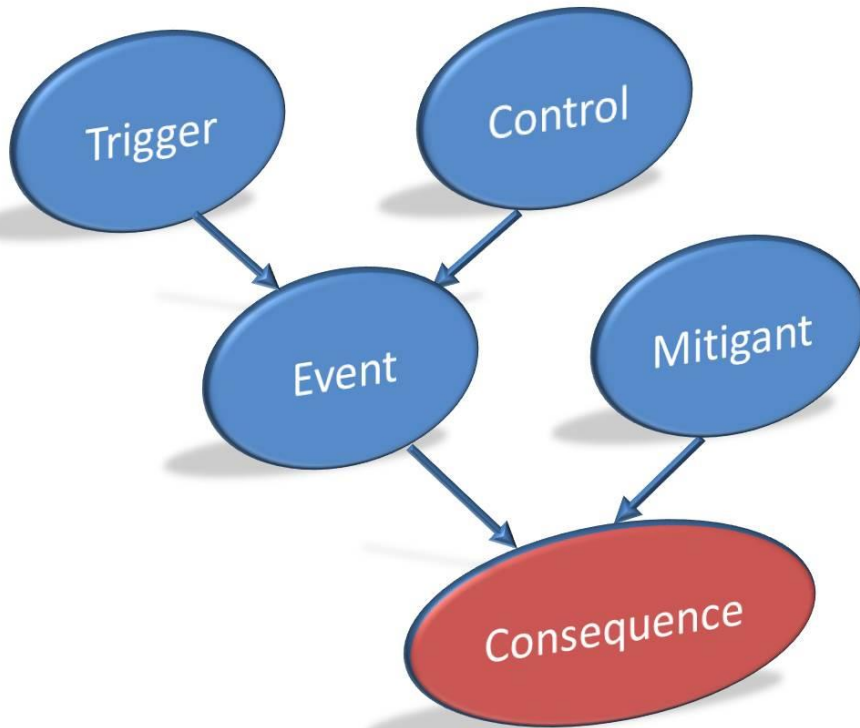
# Create Your Own Process Map

- Use flow chart conventions
- You can add symbols for different types of activity (data input, for example)
- Or, just keep it simple

## Process Map Toolkit



# Bayesian Networks for Risk Assessment



- Bayesian networks:  
<https://www.kdnuggets.com/software/bayesian.html>
- Bayesian Network Tools in Java:  
<http://bnj.sourceforge.net/>
- Getting started:  
<https://www.loginworks.com/blogs/how-to-perform-a-risk-assessment-with-data-analytics/>

# Bayesian Networks for Risk Assessment

- ◆ A Bayesian network, Bayes network, belief network, Bayes model or probabilistic directed acyclic graphical model is a probabilistic graphical model that represents a set of variables and their conditional dependencies via a directed acyclic graph. [Wikipedia](#)
- ◆ Getting Started: <https://towardsdatascience.com/introduction-to-bayesian-networks-81031eed94e>
- ◆ Bayesian networks with Java (free & open source) <https://stackoverflow.com/questions/10298739/api-for-bayesian-networks-with-java>
- ◆ SourceForge: <https://sourceforge.net/projects/unbbayes/>