Role of LNG in Hybrid Energy Networks

Research Overview

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Goal

Develop a Algorithm to manage the hybridisation of coupled, distributed, renewable multi-commodity energy networks in an Urban and Industrial environment from a sustainable point of view.
Goal

Sustainable regional energy systems planning

- Technological factors
  - Power conversion technology
  - Heat conversion technology
  - Processing technology
- Environmental factors
  - Pollutants emission
  - Environmental capacity
  - Emission reduction
- Social factors
  - Energy availability
  - Energy supply security
  - Electricity demand
- Economic factors
  - Energy price
  - Generation cost
  - Capacity expansion cost

Energy system model of Baichuan

- Clean energy
  - Nature gas
  - Hydropower
  - Solar
  - Wind
- Others
  - Raw coal
  - Crude oil

Energy conversion

- Energy generation
- Power generation

Energy process

- Coking
- Oil refining
- Coal washing

Infrastructure

- Electricity grid
- Heating network
- Transportation network

End users

- Resident
- Commerce
- Industry
- Transportation
- Agriculture
- Building
- Others

Uncertainty

- Different conversion techniques
- Various conversion efficiencies
- Fluctuant fuel/electricity prices
- Diverse environmental policies
- Limited energy resources

Membership functions

- Probabilistic distributions
- Risk of constraint violation
- Feasibility of constraints
- Satisfaction of goal

Policy analysis

- Clean energy development
  - Nature gas
  - Hydropower
  - Solar
  - Wind
- Emission reduction
  - Sulfur dioxide
  - Nitrogen oxides
  - Inhalable particles

An interactive fuzzy chance-constrained resolution (IFCR) method

Energy processing

Optimized solution

Electricity generation

Heat generation

Capacity expansion

Pollutants emission

System cost
Example

Hybrid Energy Network

Multi Energy System

Conversion

Industrial Process

RES

Electricity

N gas

Electricity

Heat

conversion
Current Case Study

Publication:
Research questions

What factors and technology advancements will facilitate the sustainable integration of industrial process?

What is the potential of using integrated decentralized energy system to reduce the local imbalance volume between local energy demand and local energy generation?
Research questions

What would be the adequate algorithm for sustainable energy management with respect to current energy system requirement and market structures?

What is the added value of using industrial processes in hybrid energy systems in compensating for the uncertainties regarding renewable energy generation and market development?
Research Approach

Investigation energy management systems.

Investigation into process integration with distributed energy systems.

Develop Multi-objective optimization under uncertainty for dynamically energy management

Energy generation at the front door.

Demonstration (Practical Set-up)
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