



# Gas Quality Cost Benefit Analysis

## Modelling the European gas market

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# Pöyry Energy Consulting



- The leading advisor to the European energy sector
- A pan-European energy consultancy formed from the merger of five highly respected consultancies



- Over 250 energy market experts in 14 offices across Europe:
  - Copenhagen – Düsseldorf – Helsinki
  - Madrid – Milan – Moscow
  - Oslo – Oxford – Paris
  - Stockholm – Stavanger – Vienna
  - Villach – Zurich

# Pöyry Energy Consulting supports clients throughout the energy business

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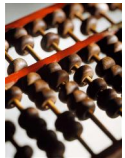
## Strategy

We help our clients to build stronger, more competitive, long-term positions throughout the energy value-chain, by focussing on the goals and activities that generate value



## Business Operation

We improve the performance and competitive position of our clients by developing and implementing innovative energy markets solutions



## Valuation & Financing

We apply our extensive expertise, projections and models to the valuation of businesses, projects and contracts to assist in the financing of our clients' energy market activities



## Sustainability

Delivering long term success increasingly requires companies to demonstrate environmental competence and social responsibility in their actions. Our experience helps us to find sustainable solutions for business and the wider environment

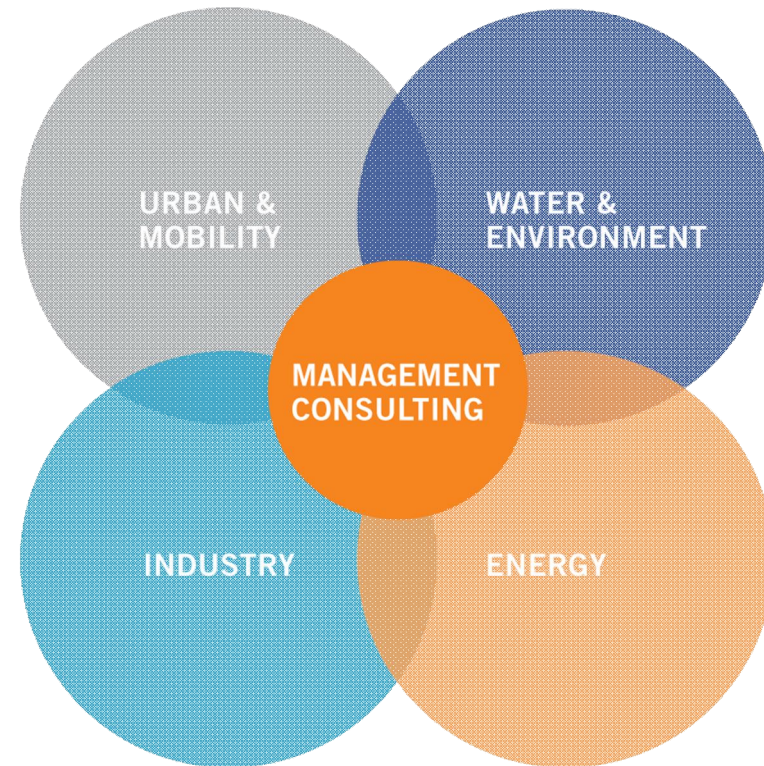
## Clients

Utilities  
Generating Companies  
Wholesalers  
Traders  
Distribution Companies  
Shippers  
Retailers  
Market Operators  
Independent System Operators  
Transmission Companies  
Governments  
Large Consumer  
Regulators  
Non-Governmental Organisations  
Financial Institutions  
Trade Associations  
Manufacturing Companies

# Pöyry plc – Global experts in consulting and engineering

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- Pöyry is a global consulting and engineering company dedicated to balanced sustainability
- 7000 experts in about 50 countries
- Project experience in more than 100 countries
- 17 000 projects annually
- Net sales in 2009 EUR 674 million
- Listed on the NASDAQ OMX Helsinki since 1997



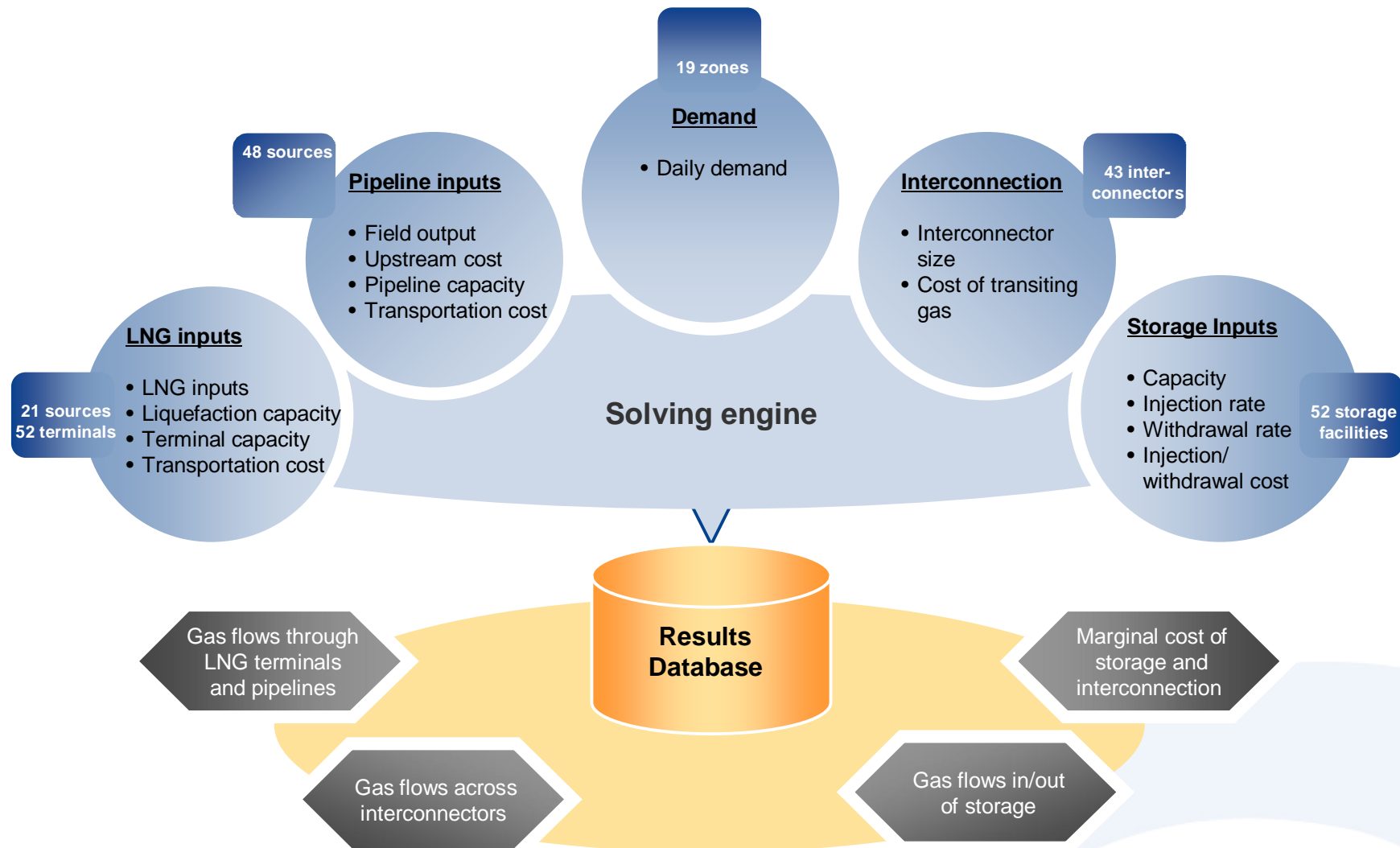
Urban planning – Real estate development – Transport planning – Rail infrastructure – Road infrastructure – Construction management – Building design – Pulp and paper – Chemicals – Biorefining – Water supply and sanitation – Water resources management – Geosciences – Environmental services – Environmental consulting – Hydropower – Renewable energy – Thermal power – Oil and gas – Nuclear energy – Transmission & distribution

## Our current model - Pegasus

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- A 19-zone model incorporating
  - GB, Ireland, Spain & Portugal, France, Belgium & Luxembourg, Netherlands, Germany, Denmark & Sweden, Poland, Slovakia, Czech Republic, Austria & Hungary, Switzerland & Italy, Romania, Turkey, SEE, the US and Far East
- Incorporates a simplified model of the US market, allowing us to fully capture the Atlantic basin LNG market
- Examines supply and demand at daily resolution
- Powerful Linear P
- Fully coded tool which allows scalability and adaptability to a number of problems

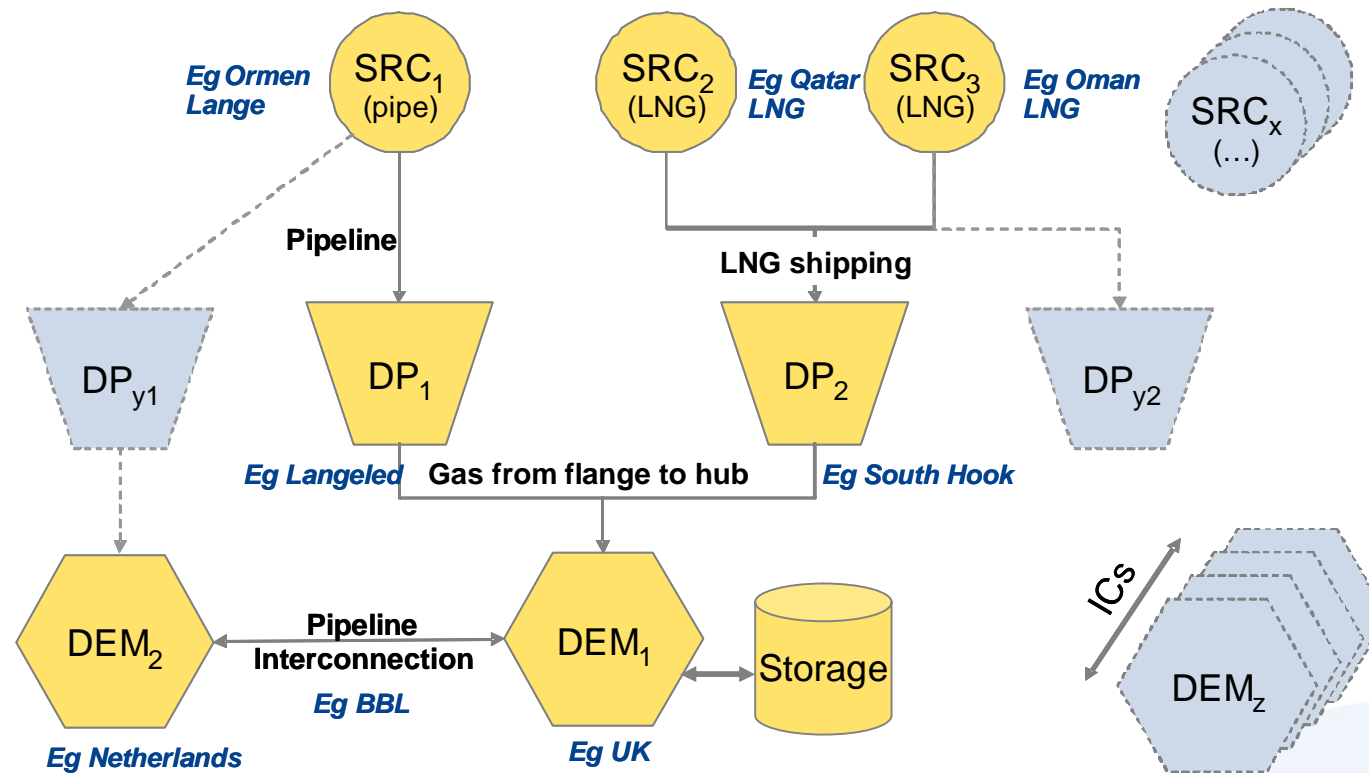
# Pegasus structure





# Sources, Delivery Points and Interconnectors

Pegasus separates the gas world into Demands (DEMs), Sources (SRCs), Delivery Points (DPs) and Interconnectors (ICs)



**minimise** the aggregate cost of supplying all demands for gas over the year,  
**subject to** various constraints (capacities, day-to-day storage operations, etc.)



## What can Pegasus do?

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- It will tell you how much gas should cost in any zone and where that zone's gas should be coming from
- It projects market prices out to 2030
  - assists project valuation
  - good performance at monthly resolution
  - important input into electricity and other modelling
- It models zonal gas flows into and out of a zone
- It projects facility utilisation rates
  - LNG terminals
  - Storage facilities

## It is challenging to model Europe's gas market

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- The real markets are very complex
  - Limited transparency
  - Conflicting interests
  - Economically irrational behaviour
  - Unforeseen and unforeseeable events
- Modelling complexity leads to mathematical complexity
  - Run-time issues
  - Data accuracy and availability

## We handle complexity in Pegasus with some simplifications

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- Perfect foresight, perfect decisions
  - ⇒ Storage utilization minimised
  - ⇒ Transportation costs/distances minimised
  - ⇒ LNG dispatched in perfect time at perfect quantities
- Limited contract model and gas-year optimization
  - Take-or-pay considerations aggregated
  - Limited contract information
  - No carry-over, destination clauses, etc.
- Zonal aggregation and simplification
  - 19 European zones to model EU-27
  - Simple US, Far East, rest of world zones

## Pöyry's developments in modelling gas markets - Gas Intermittency

- “Exploring The Effect Of Wind Intermittency  
On Gas Trading, Storage & Transmission”
  - James Cox, Flame main conference, Wednesday
- Day-to-day flexibility
  - Important to handle much of the markets' complexities differently
- Perseus gas model
  - Zephyr wind/electricity model

# Perseus gas model – Summary

A unique gas model that simulates worldwide gas markets with realistic historical weather patterns

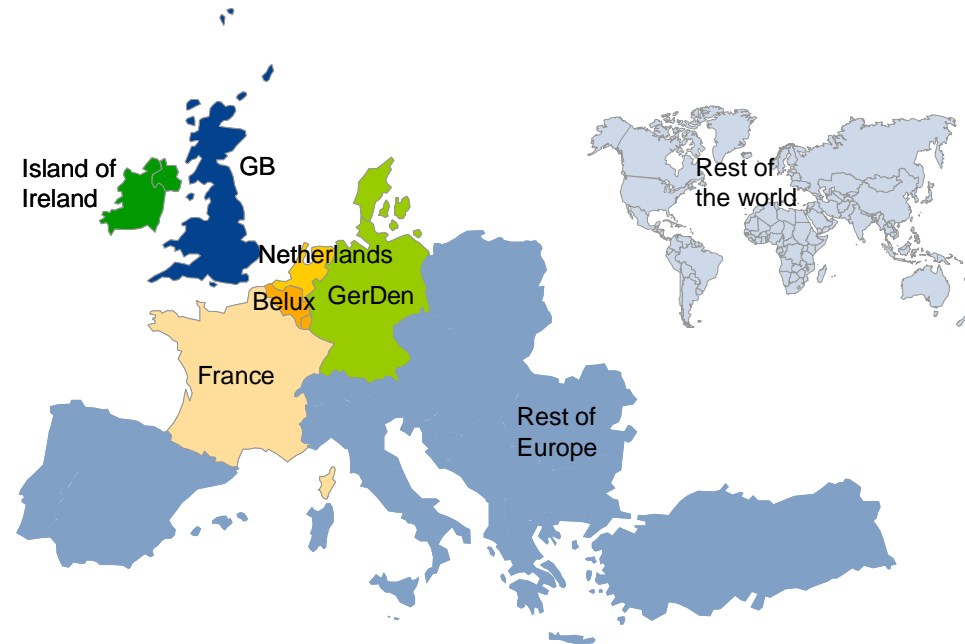
- **Realistic daily gas demand** based on underlying weather patterns (both non-power and power sectors)
  - **10 historical weather patterns** are run for each future year

- **Rolling Optimisation** removes perfect foresight

- **Realistic LNG supply** is incorporated by ‘locking down’ LNG flows 7 days in advance

- **Fundamentals-based gas storage** usage – based on day-to-day varying demand and supply

- **Realistic daily prices**

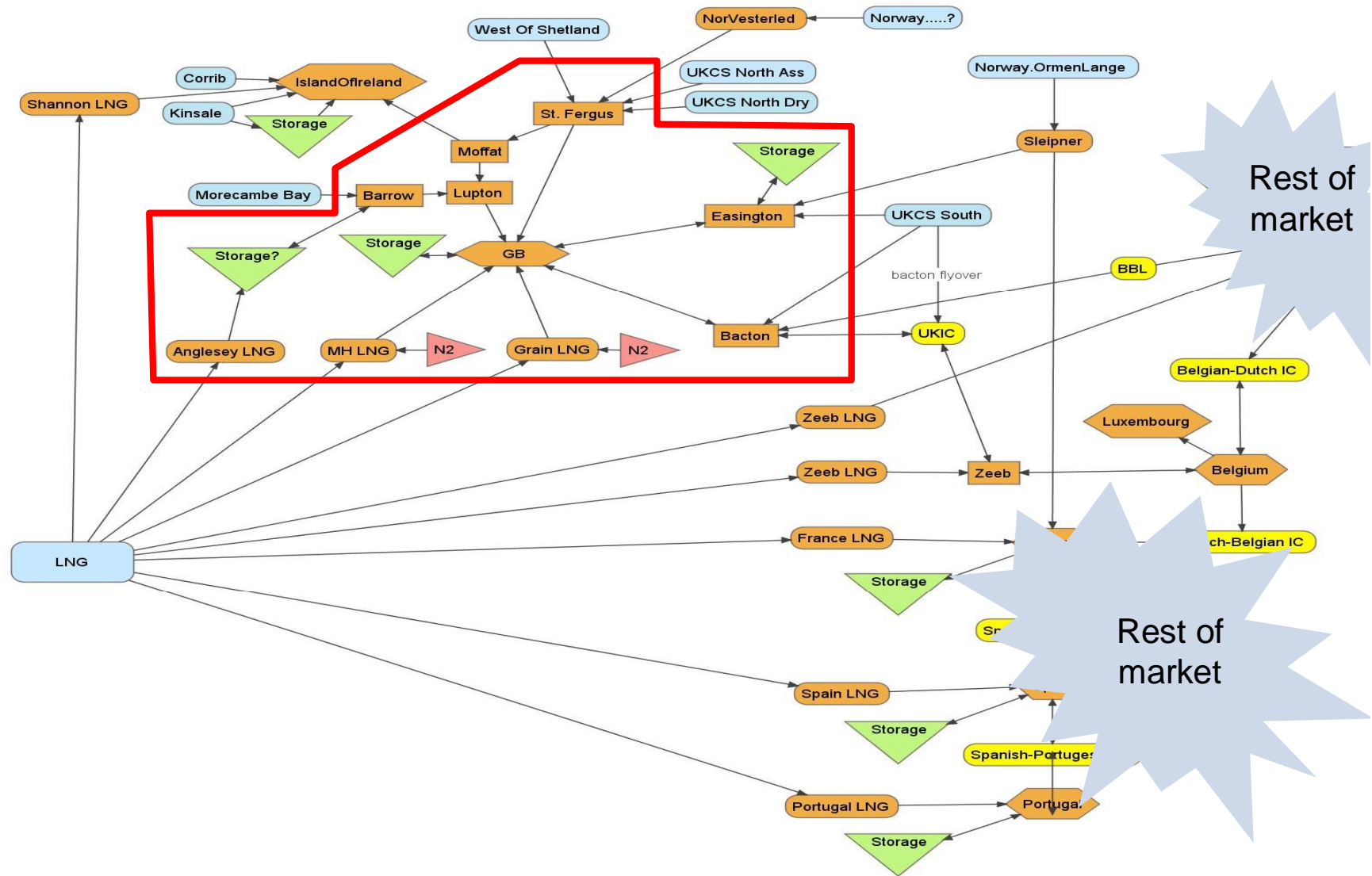


## Modelling developments needed for this project

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- Starting point: Pegasus and Perseus
- Incorporation of gas quality parameters
  - Two-pass model – solve for flows then solve for quality, re-run if necessary
- Expand to incorporate EU27 as distinct entities
- In practice, many more “gas quality” zones – 100+
- Migrate to 64-bit multi-core computing platform
- Modular construction
- Include both Pegasus **and** Perseus maths
- Fully nodal representation
- Spatial/graphical interfacing

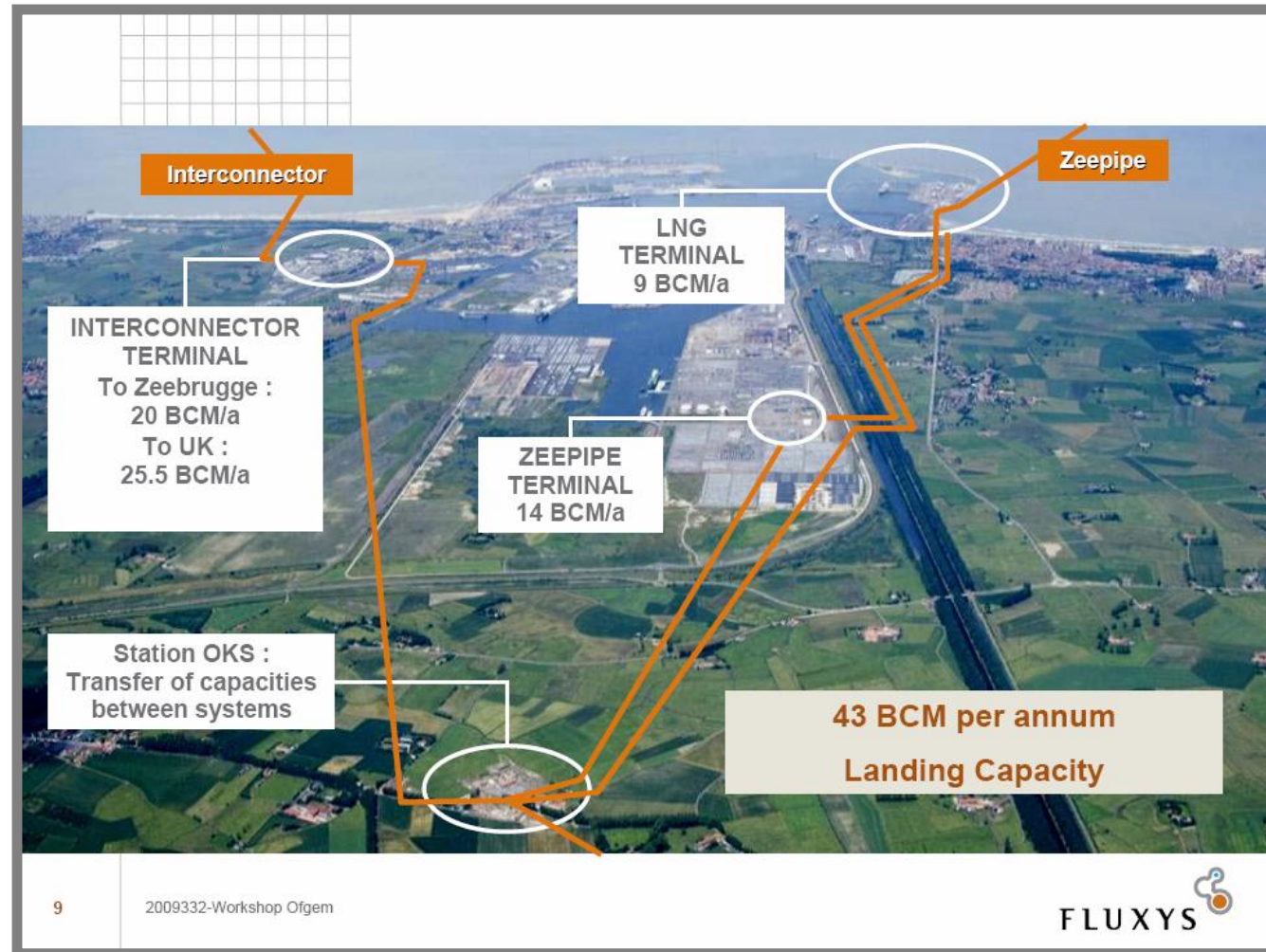
## Potential disaggregation – e.g. GB market possibly 10 zones





## Pöyry aware of similar considerations elsewhere

- Zeebrugge arrangements



## Information required

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- Physical configurations and constraints
- Costs of gas processing
  - Capex
  - Operating – fixed
  - Operating – variable
- Contracts
  - Gas quality requirements/expectations
  - Quantities, take-or-pay restrictions, carryover tolerances, etc.
- Gas qualities
  - Russia, North Africa and middle East
- If necessary information will be held in confidence within the project

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