Gaining an edge

Identifying LNG value: approach & case studies

Briefing pack Sep 2019

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Contents

Identifying LNG value
5 key challenges

Challenge	Summary
1. Value chain interdependence	• The value of LNG assets within a portfolio is interdependent, given physical & contractual complexity of the LNG supply chain. • Valuation needs to be tackled on a portfolio basis, recognising asset interactions & constraints.
2. Bespoke business models	• Each LNG business model & portfolio has bespoke analytical requirements. • E.g. 'trader' portfolio focus on optionality vs 'producer' portfolio focus on physical delivery.
3. Illiquid markets	• Despite rapid growth, the LNG market remains relatively illiquid & has complex logistical constraints. • This creates a challenge in valuing / hedging complex (e.g. non linear) exposures.
4. LNG price behaviour	• Standard pricing models don't capture complex relationships across LNG price markers. • E.g. Levels of spreads, volatility & correlation depend on 'state' of the market (tight vs oversupplied).
5. Lack of standardised methodologies	• Because of the 4 issues above there is a lack of standardised methodology for LNG analytics. • As a result, companies are developing bespoke solutions (albeit using common building blocks).

Creating & analysing LNG portfolio value

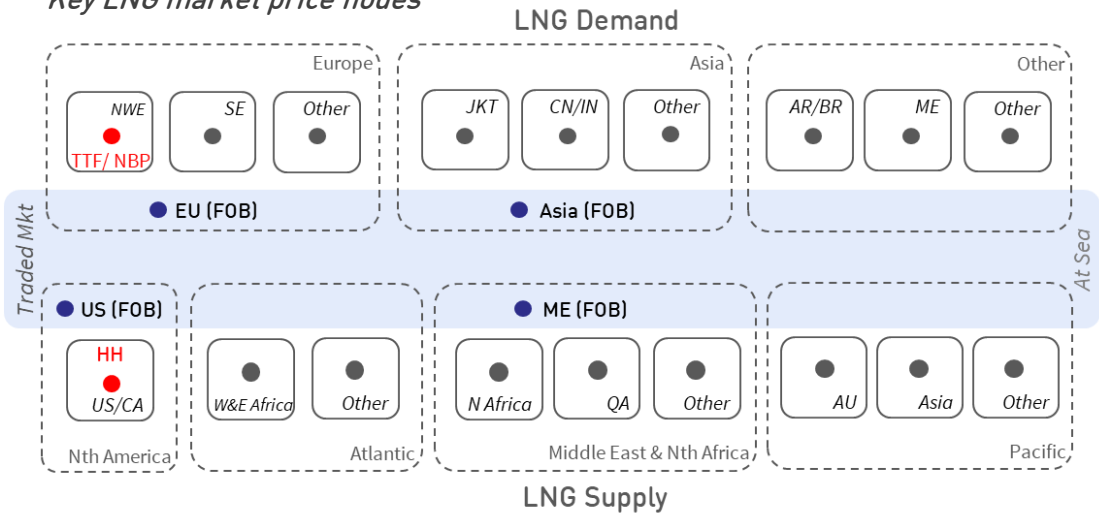
How is value created?

- Value is created via interaction between:
  1. Constraints & stress points in the LNG supply chain
  2. Changes in market dynamics
- Value is captured via constructing & optimising an appropriate combination of portfolio components & optionality.

Analytical breakdown

- LNG portfolios can be simplified using price 'nodes' and asset 'exposures'
- Prices act on exposures to drive value.
- So analytical representation required of:
  (1) portfolio exposures (e.g. commodity positions, asset flex & constraints)
  (2) price dynamics (price level, spreads, correlations, volatility)

Key LNG market price nodes



Categories of LNG portfolio exposures

Exposure	Examples
Linear price	• cargos, futures / swaps (TTF, JKM, Brent) • shipping capacity
Linear spread	• locational price spreads (e.g. HH vs TTF vs JKM) • time spreads (e.g. Sum vs Win)
Non-linear commodity	• LNG supply obligations e.g. seller / buyer volume flex rights • embedded options e.g. calls/puts on TTF/JKM/Brent
Non-linear spread	• locational spread options e.g. diversion optionality • time spread options e.g. bankability flex or storage

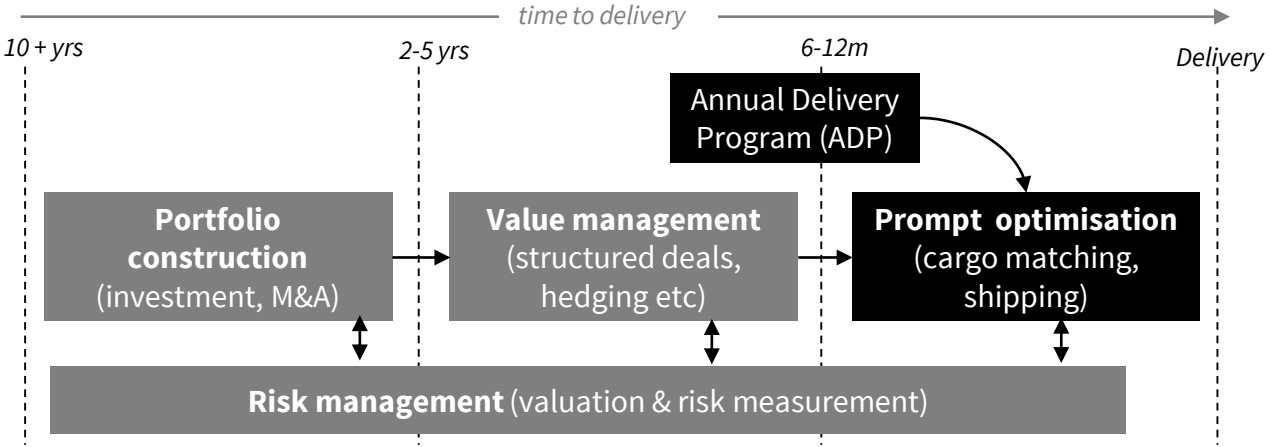
Source: Timera Energy

Choosing the right weapon for the hunt

There are several key analytical challenges that commercial & operational LNG teams face:

Challenge	Focus	Example
Prompt optimisation	Short term physical cargo logistics	Create/reoptimise ADP given shipping/contract constraints & market moves
Value management	Hedging & structured deals	Manage portfolio value/exposures via hedging, structuring & ST/MT deals
Portfolio construction	Asset investment, LTCs and M&A	Unlock/create incremental portfolio value via new assets/LTCs or M&A
Risk management	Identifying/measuring/limiting risk	Mark to market exposures & effectively measure & limit portfolio risk

Core commercial business activities underpinned by portfolio analytics



Two key categories of weapon

The two categories

- LNG portfolio analytics challenges can be grouped into two categories:
  1. Portfolio construction & value management
  2. Prompt optimisation

Important differences

- Careful treatment required of the boundaries between these two approaches
- Key differences in defining an analytical solution for each are:
  1. the treatment of commodity price uncertainty
  2. the level of detail required in portfolio representation

Two key analytical approaches

	Portfolio construction & value management	Prompt optimisation (cargo & shipping)
Objective	Quantify value & risk impact of portfolio changes & commercial strategy decisions	Define Annual Delivery Program and final optimised schedule of cargo deliveries
Horizon	6 mths – 20 yrs	< 3-12 mths
Key drivers	• Interaction between portfolio flexibility & price uncertainty • Impact of hedging strategy	• Specific contract terms and locked in cargo matches • Detailed vessel costs / attributes.
Analytical approach	• Robust representation of portfolio flex & price uncertainty • Simplified vessel representation	• Portfolio optimised against known prices and costs • Detailed shipping representation

Note These two approaches map onto the grey & black boxes on diagram on previous page.

How are LNG analytics implemented in practice?

4 case studies

1. Prompt optimisation
2. Portfolio valuation model
3. Regas valuation
4. Flexible contract analysis

Case study 1:
LNG prompt optimisation

Challenge: Create a tool to regularly reoptimise LNG cargo matching & voyage schedule for complex global LNG portfolio

Our solution: We built a sophisticated shipping & cargo optimisation decision support tool (focus next 3-6 months)

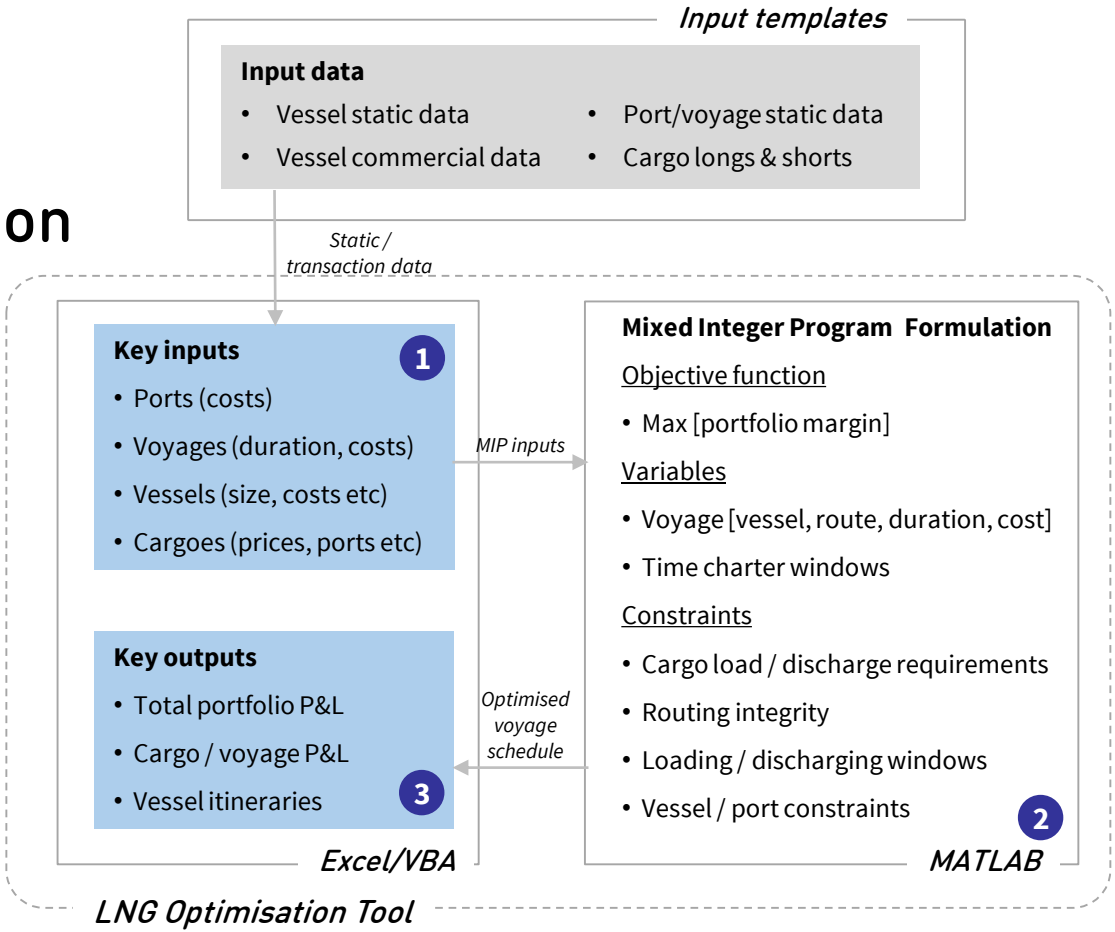
Client: Large midstream LNG company

Basic approach

Generate a set of independent feasible voyages, select optimal set of voyages using a Mixed Integer Program (MIP)

Process steps

1. Reads in input data
   Generates a set of feasible voyages
2. MIP solved using internal solver
3. Results in Excel (report templates)



Key focus for outputs

- Identifying high value "trades" (portfolio reoptimisation actions)
- Defining outputs that explain "trades" (build up of value changes)

Case study 2: LNG valuation framework

Challenge: Create a tool to identify& quantify LNG portfolio valuation opportunities (e.g. new assets, LTCs)

Our solution: We built an LNG valuation analysis framework to support global LNG portfolio strategy development

Client: LNG trading company

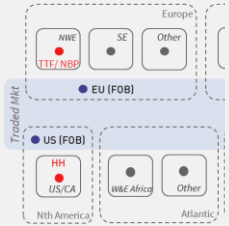
Key features

- Objective was to set-up base portfolio and then use the framework to assess value and risk impact on alternative strategies to evolve the portfolio.
- Alternative price scenarios were used to assess how portfolio performed under different market conditions.
- Flexible decision support tool was delivered to allow client to continue to run alternative analysis.

LNG valuation framework overview

1. Define commercial topology

- Value chain definition / scope
- Locations / markets



2. Flexible portfolio definition

- Contracts: complex pricing, seller & buyer volume flex & constraints (incl. portfolio)
- Vessel details: TC Ins, distances
- Markets: hubs, cargo & vessel spot market access and prices

3. Formulate & solve

- Excel input templates to define commercial and static data
- Problem formulated as a Mixed Integer Program (MIP) & solved using external solver

4. Results & analysis

- Key results: (1) base portfolio value, optimal cargo schedule vs. (2) scenario value delta
- Key focus on outputs that explain complex inter-dependent changes

Illustrative scenarios

- Portfolio performance in “tight” vs “oversupplied” market?
- Can NWE regas unlock portfolio constraints & add value?
- Can diversion flexibility be used to manage downside risk from implied oil / gas spread exposure?

Case study 3: European regas value

Challenge: Value LT slots contract for two NW European regas terminal

Our solution: We developed tools to analyse regas value to support (1) bid for capacity & (2) capacity sales strategy

Clients: (1) LNG trading company & (2) UK regas terminal operator

Regas capacity flex value buckets

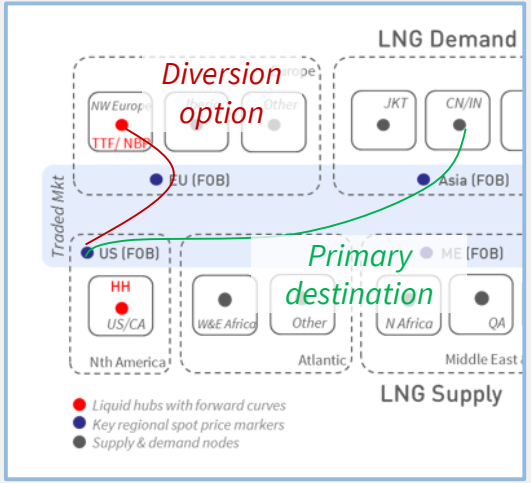
Value bucket	Description
Slot value - Merchant	Option to deliver cargo into Europe – standalone value
Slot Value - Portfolio	Option to deliver cargo into EU – incremental portfolio value
Send-out optimisation	Profiling gas send-out from tank storage to increase value
Reload value	Reload/export cargo option

Illustrating regas portfolio value

We constructed a simple cargo diversion case study to illustrate portfolio value and estimated value of UK cargo delivery option using a stochastic diversion option valuation model.

Parameters:

- Strip of 12 (one per month) equity cargos (USGC FOB)
- Primary destination into China.
- Addition of UK regas creates option to divert to UK (0.5 $/mmbtu shipping cost saving).
- 1.2 $/mmbtu Asia premium (over NBP).



Results:

	Benchmark	Value ($/mmbtu)	Diversion probability
Diversion option value	Low value	0.4	0.09
	High value	0.9	0.15

Source: Timera Energy

Notes

- *Values calculated using our bespoke stochastic LNG contract model.*
- *High / low values characterised by assumed levels of volatility.*
- *Excludes US export optionality (assumes loaded cargo).*

Case study 4:
LNG contract flex model

Challenge: demonstrate & quantify the value of diversion optionality in contracts.

Our solution: We built an LNG supply contract valuation tool (focus on understanding/pricing diversion flex value)

Client: Large LNG producer

1. Analytical methodology

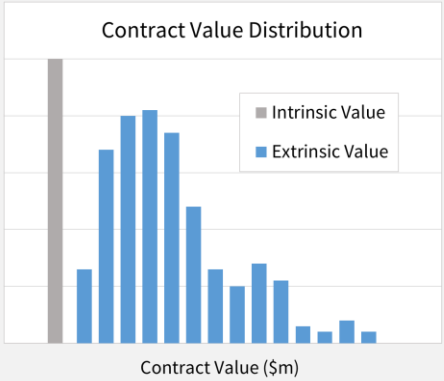
1. Rolling spot and forward simulation:
   - Optimise contract against current prices
   - Simulate spot and forward prices
   - Reoptimise & adjust hedges if profitable.
2. Constrained basket of spreads.

2. Key features

- Complex index pricing (average / lag etc)
- Diversion rights (primary & diversion destinations)
- Cancellation costs (as a function of time to delivery)
- Range of temporal constraints:
  - min/max cargoes on different (overlapping horizons)
  - per slot, monthly, quarterly, seasonal, annual & custom

3. Model outputs

- Intrinsic / extrinsic value (total / by cargo)
- Value distributions
- Cargo schedules (ADP / intrinsic) & deltas



Timera Energy offers expertise on value & risk in energy markets

Specialist energy consultancy
Focus on LNG and European gas & power assets

Extensive industry expertise
Practical knowledge from senior industry roles

Pragmatic commercial focus
Investment, valuation, contracting & mkt analysis

Strong client base
leading energy companies (producers, utilities, funds)

Leading industry blog
15,000+ regular readers, publications, conferences

Our clients include

Timera Energy LNG analytics credentials

Project	Client	Summary
LNG shipping tool	Producer	Developed a shipping optimisation model for major LNG portfolio player
LNG portfolio model	LNG trader	Built LNG portfolio valuation analysis framework tool
NWE regas value	Trader	Analysis of evolution of NW European regas capacity value under different scenarios
LNG flex contract analysis	Producer	built an LNG contract valuation tool for analysing / pricing diversion flex value
LNG market evolution	Fund	Analysis of evolution of LNG market & interaction with European hubs
LNG market analysis	Fund	Analysis of evolution of LNG flows into Europe and impact on regas capacity value
LNG supply contract	Oil major	Advice on valuation/restructuring of long term European LNG supply contract
LNG risk support	LNG trader	LNG Risk Management methodology advice (e.g. curves building, EaR methods)
Supply flex value	PE Fund	Analysis of gas flexibility value (price spreads, volatility) at European hubs
LNG contract advice	Producer	Advice/analysis of pricing & exposure management of LNG supply contracts

Timera Energy gas team members

Our team members have extensive senior industry experience and practical commercial knowledge.

May Mannes

30 years gas industry experience (Statoil, Eclipse, Platts)
Expert in LNG market analysis and modelling
Senior commercial LNG & gas market background

David Stokes

20+ years energy/commodity market experience
Expert in investment/monetization of flex gas assets
Industry roles with Origin, Williams, JP Morgan

Jessica Gervais

10 years commercial & analytical energy market experience
Strong gas market analysis & modelling expertise
Gas trading & commercial analytics industry background

Olly Spinks

20+ years energy industry experience
Expert in gas storage valuation analysis
Ran BP's gas, LNG & power commercial analytics function

Howard Rogers

30+ years gas industry experience (BP, OIES)
Expert in fundamental analysis of gas markets
Chairman of Gas Research Programme at OIES

Henry Crawford

8 years experience in energy & capital markets
Strong commercial & market analytics experience
Gas trading & analytics background (Nova Energy)

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