



European gas market in transition

Market drivers & commercial implications

Oct 2018

www.timera-energy.com

TIMERA
ENERGY

Contents

Section	Contents	
5 key takeaways	Executive Summary	3
European market balance	Aggregate supply & demand curve summary	4
3 key drivers of hub prices	1. LNG flows	6
	2. Power sector switching	7
	3. Russian flows	8
Global market balance	LNG market Supply & Demand balance	9
Price evolution	3 potential paths for TTF prices (2019-25)	10
	TTF spot price volatility and seasonal price spreads	11
3 commercial challenges	A. Asset value capture	13
	B. Portfolio construction	14
	C. Asset investment	15
Timera & European gas	Services, credentials, team & analytical capability	16

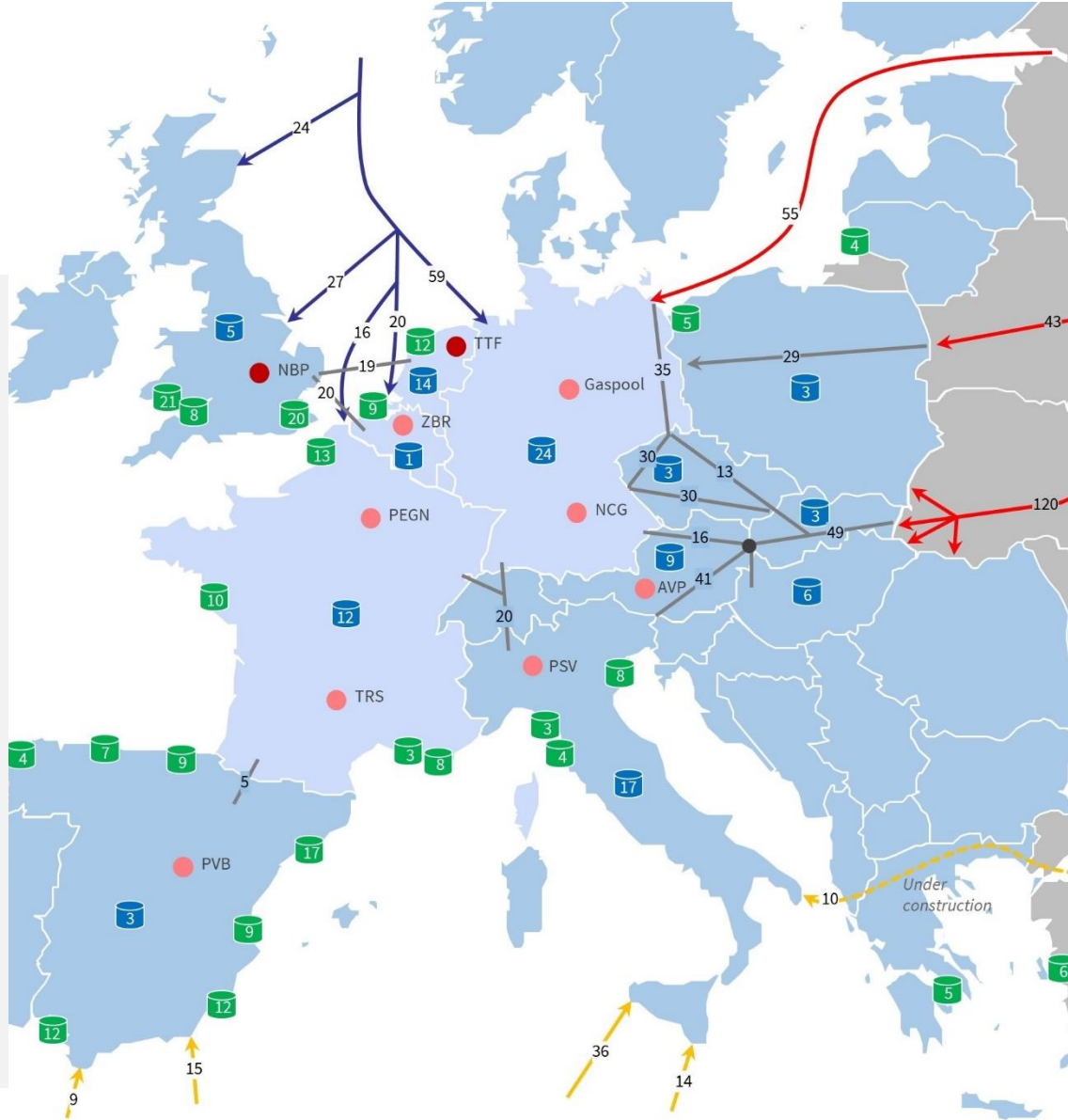
Disclaimer

While Timera Energy Limited considers that the information and opinions given in this work are sound, all parties must rely upon their own skill and judgement when interpreting or making use of it. The examples, facts, and analysis summarised in this report represent our interpretations. Nothing herein is intended to provide investment advice. Timera Energy Limited cannot, and does not, accept liability for losses suffered, whether direct or consequential, arising out of provision of this report. No warranty or representation is provided, nor liability assumed, in relation to the report's accuracy, completeness, suitability or validity.

European gas:

5 key takeaways

1. **Market tightening:** TTF price has doubled since Jul 2017. Risk shifting from 'oversupply' (2019-21) to 'deficit' (2022-25).
2. **Price drivers:** 3 key current drivers of hub prices at the margin:
 - i. LNG flows
 - ii. Power switching
 - iii. Russian flows
3. **Value capture:** Market evolution and roll-off of LTCs pushing asset value closer to delivery. Challenge → capture/hedge.
4. **Portfolio construction:** Gas portfolios refocusing within supply chain as role of gas evolves (power, LNG, trading key).
5. **Asset investment:** Asset value opportunities recovering with market. But with structural shifts in asset risk/return profiles.



Global gas market is tightening

Europe

- TTF/NBP prices have doubled since Summer 2017 from 5 to 10 \$/mmbtu.
- Half of this price move has happened since Jul 2018.

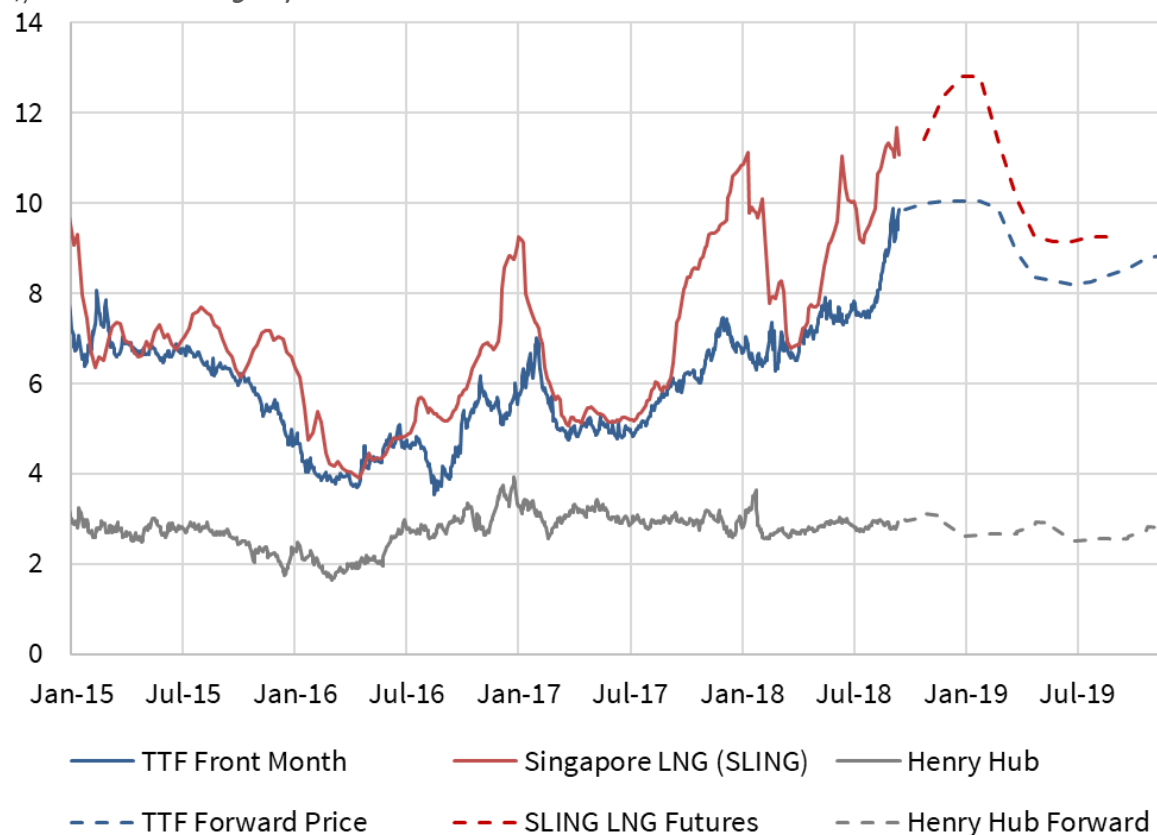
Asia

- Asian spot LNG prices have followed TTF higher ('TTF floor').
- Spot prices need to maintain a spread over TTF to attract adequate LNG to meet strong Asian demand.

US

- Market remains well supplied and decoupled from Europe/Asia.

\$/mmbtu Global gas price benchmarks



European supply & demand balance

1. LNG flows expand & contract based on Asian requirement. LNG currently being diverted to Asia (shifting supply curve left).

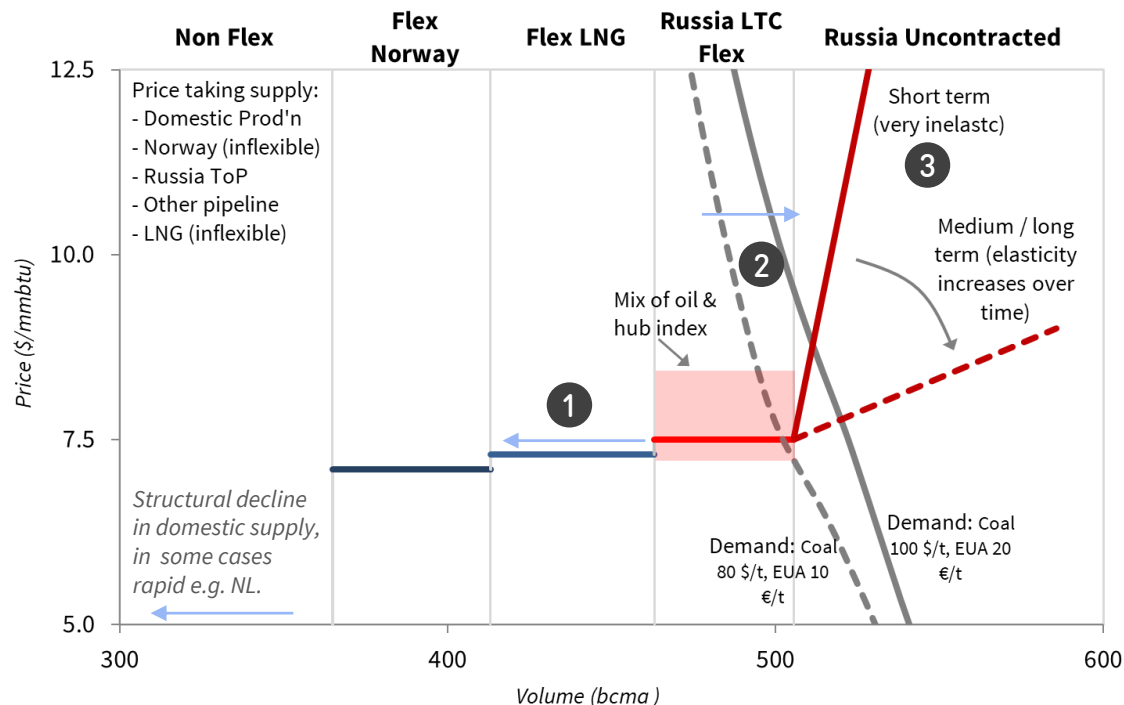
2. Power switching drives demand curve shape/position. Coal & CO2 price rises pushing demand curve to the right.

Aggregated European gas market balance (2019)

What is driving hub prices?

3 key factors driving marginal pricing:

Driver	Description
1 LNG flows (Asia / TTF spot price signal)	Europe LNG import volumes expand & contract based on Asian requirements
2 Power switching (Coal/CO2 spot price signal)	Relative CCGT vs coal plant variable costs drive power sector gas demand
3 Russian flows (eroding oil price linkage)	Russian gas volumes driven by LTC nominations & Gazprom volume strategy/logistics



3. Russian flows are dominating marginal price setting. Steep ST supply curve given strategic/logistical flow response constraints. This is contributing to 2018 surge in TTF prices. LT supply curve much flatter given 80+ bcm/a of shut in Russian production capacity & incentives to discourage new LNG project FIDs.

Key driver 1: LNG flows

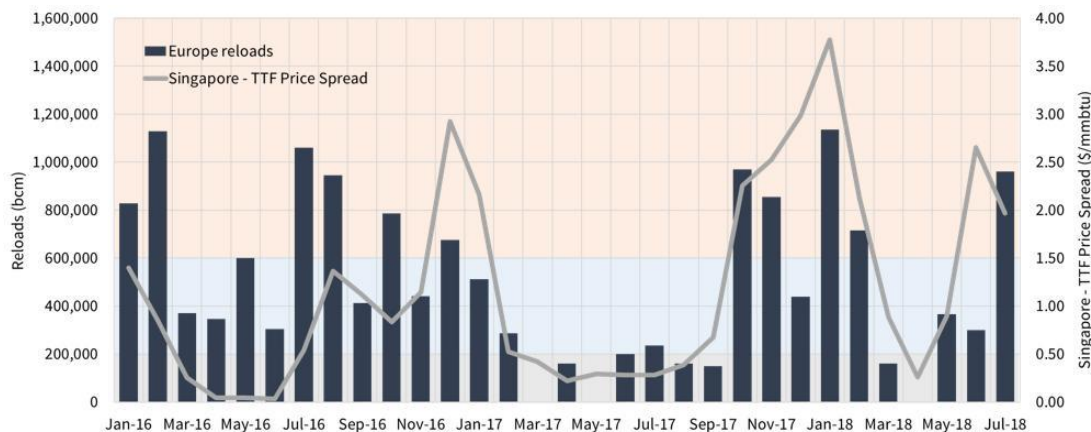
LNG role in European supply mix

- Large volume of LNG flow into Europe is flexible (i.e. price responsive).
- Key price signal is Asia LNG vs TTF spot price spread. LNG flows vary depending on spread 'state' (see chart & table).
- European gas supply curve expands & contracts depending on spread level.

Current LNG flow dynamics

- Asian gas storage constraints (e.g. China) drive seasonality in LNG flows.
- Asia/TTF spread has risen over last 3 winters, drawing LNG from Europe to meet strong Asian demand.
- Spread has remained higher over summer 2018, as tighter European & Asian markets have competed for available LNG supply.

Asia/TTF price spread states & reload volumes



Source: Timera Energy

3 Asia/TTF spread states drive flow dynamics

State	Spread range	Flow dynamics
Converged	0.0 – 0.5 \$/mmbtu (grey)	TTF/Asian spread doesn't cover incremental cost of flowing LNG to Asia. Flex LNG supply tends to flow to Europe, putting downward pressure on TTF.
Ranging	0.5 – 1.5 \$/mmbtu (blue)	Asian requirement for incremental LNG supply. Flex supply diverted from Europe to balance LNG market. Reloads viable towards top of this spread range.
Diverged	1.5+ \$/mmbtu (red)	Temporary constraints in LNG supply chain to meet Asian demand. Higher prices required to incentivise diversion of less flex cargoes & higher cost reloads.

Note: Asian/TTF spreads are also impacted by shipping charter rates. A surge in charter rates in 2018 (35k \$/day to 100 \$/day) is increasing the cost hurdle for moving LNG to Asia.

Key driver 2: Power switching

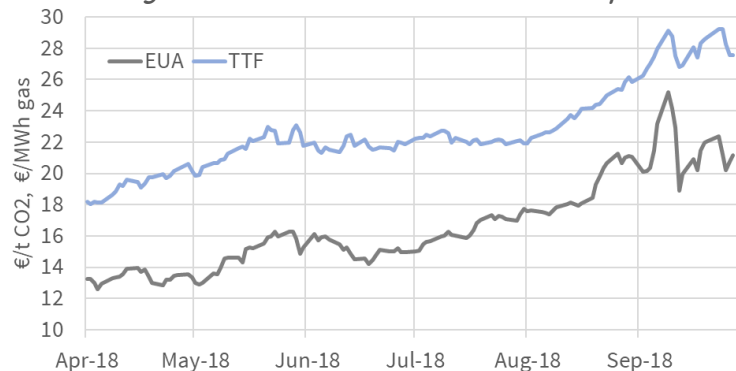
Switching role in driving gas demand

- The position & slope of the European gas demand curve is driven by power sector switching dynamics.
- Hub prices can increase as a result of two factors:
 - D curve shift: rise in coal & CO2 prices shifts demand curve to the right i.e. TTF must rise to maintain same level of CCGT vs coal switching and gas demand.
 - S curve shift: contraction in gas supply shifts supply curve to left along demand curve, increasing relative SRMC of CCGTs vs coal & reducing gas demand.

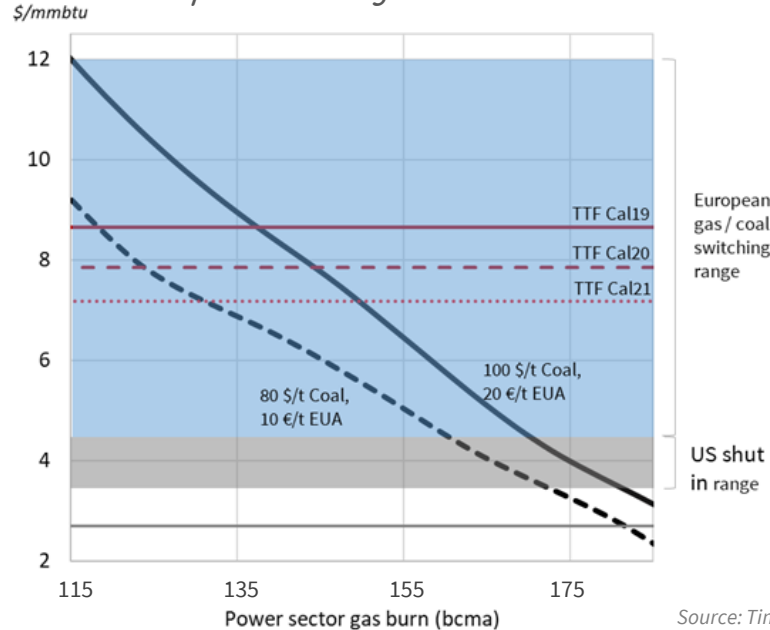
Current switching dynamics

- Jul – Sep 18 TTF rise from 7.5-10 \$/mmbtu has been mainly driven by a doubling of CO2 prices (D curve shift).
- Switching levels (& S curve) have been relatively stable.
- Tight gas market has been a function of D curve shift to the right (Coal/CO2) & inelastic Russian supply response.
- In a tight market, TTF has to rise to maintain switching levels to prevent power sector gas demand from rising.

Strong correlation of TTF vs Carbon EUA prices



Pan-European switching demand curves



Source: Timera Energy

Each line in the chart can be thought of as an aggregate gas demand curve for the European power sector. Lines show aggregate gas burn as a function of gas price. 2 different demand curves are shown for different coal prices.

Key driver 3: Russian flows

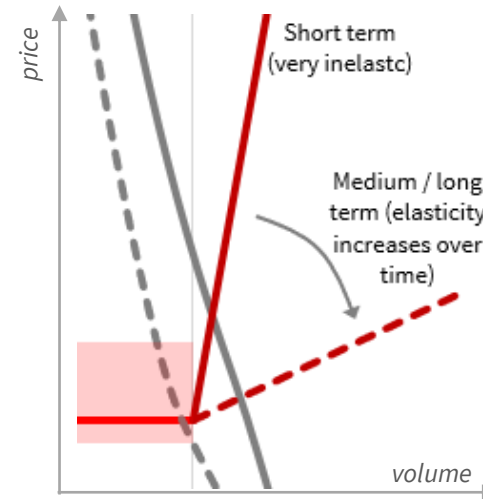
Role of flexible Russian gas

- 2 key sources of annual flex in Russian flows:
 - LT contracts: Suppliers have flex to nominate higher volumes (Max ACQ to Take or Pay).
 - Uncontracted: Gazprom has 80+ bcm of shut in production. But commercial/logistical inertia* may delay flow response to higher prices.
- Major shift in LT contract pricing to TTF indexation (as a result of Gazprom DG Comp case). This dilutes influence of oil on TTF... but it is still there.

Current Russian flow dynamics

- Northern import routes (Nordstream, Yamal) are near capacity constraints in 2018. But Gazprom can flow more uncontracted volume via Ukraine (e.g. Q4 2018 auctions).
- Current high TTF & capacity constraints convenient in ST for Gazprom to 'pressure' EU on Nordstream 2 decision.
- Winter 18/19 tight! But watch for Gazprom flow response in 2019. \$10 TTF prices not in Gazprom's LT strategic interest given it encourages LNG FIDs (e.g. Shell Canada).

Behaviour of Russian flexible gas supply

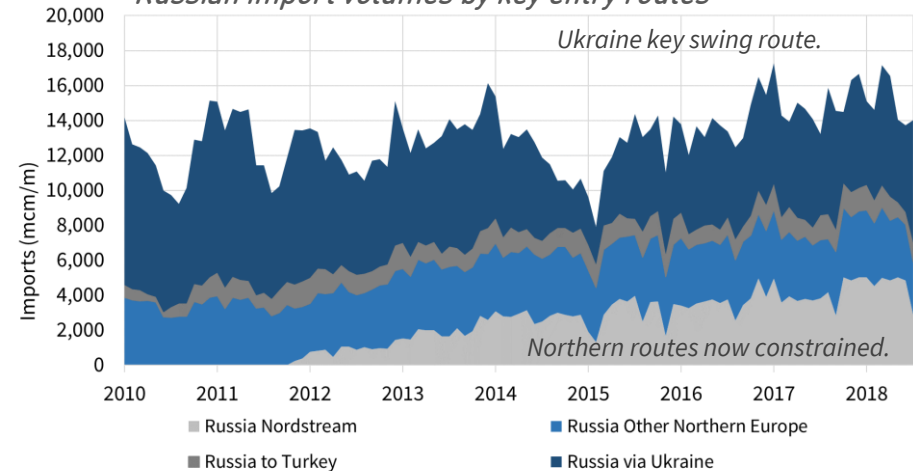


*ST - flow inertia

- Nordstream 2: High TTF & tight import capacity adds pressure on EU to approve NS2 (Q4 18 decision period)
- Logistics: Temporary upstream/midstream & commercial constraints in ramping up flows in response to prices

LT - Not in Gazprom's interest to have prices above 7-8 \$/mmbtu

Russian import volumes by key entry routes



Source: Timera Energy

Global gas market balance

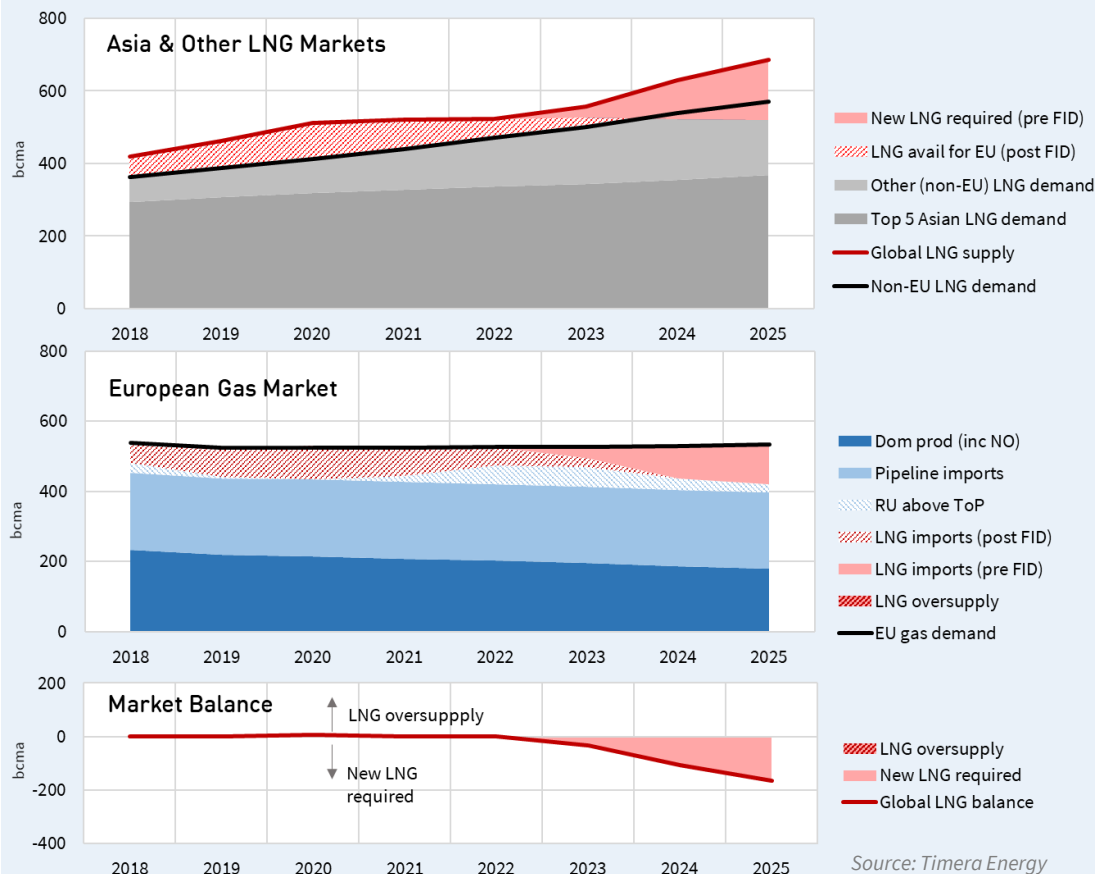
Asian demand absorbing supply

- Strong Asian LNG demand has absorbed new global supply to date.
- In addition, Asia is pulling LNG from Europe across 2018. China 2018 LNG demand ~50% above 2017 levels year to date.
- These dynamics have reduced the risk of oversupply 2019-21... but slowdown risk remains (eg China shock, global recession).

Risk of 2020s squeeze rising

- Risk of a gas market squeeze in 2022-25 rising as Asian demand outpaces supply.
- At current pace of Asian demand, LNG market needs new supply from 2022.
- Coral, Corpus T3 & Shell Canada only major FIDs since 2016 .. and are not enough.
- Timing/scale of new FIDs over 2018-19 key to tightness in 2020s & extent of Russian pricing power in European gas market.

Global market balance: High Asian Demand Scenario



- Charts show global market balance evolution given continuation of High Asian demand
- Prospect of surplus LNG flowing from Asia into European hubs has declined across 2019-21
- New LNG supply required from 2022, with deficit growing faster than volume of FIDs
- Risk to this scenario is a slowdown in Asian demand (e.g. China shock, global recession).

3 scenarios for price evolution

1. Consensus

- Current tightness eases with (i) new LNG supply online (ii) Russian flows rising.
- Prices settle in 2020s around 8 \$/mmbtu, consistent with LRMC of new LNG projects.

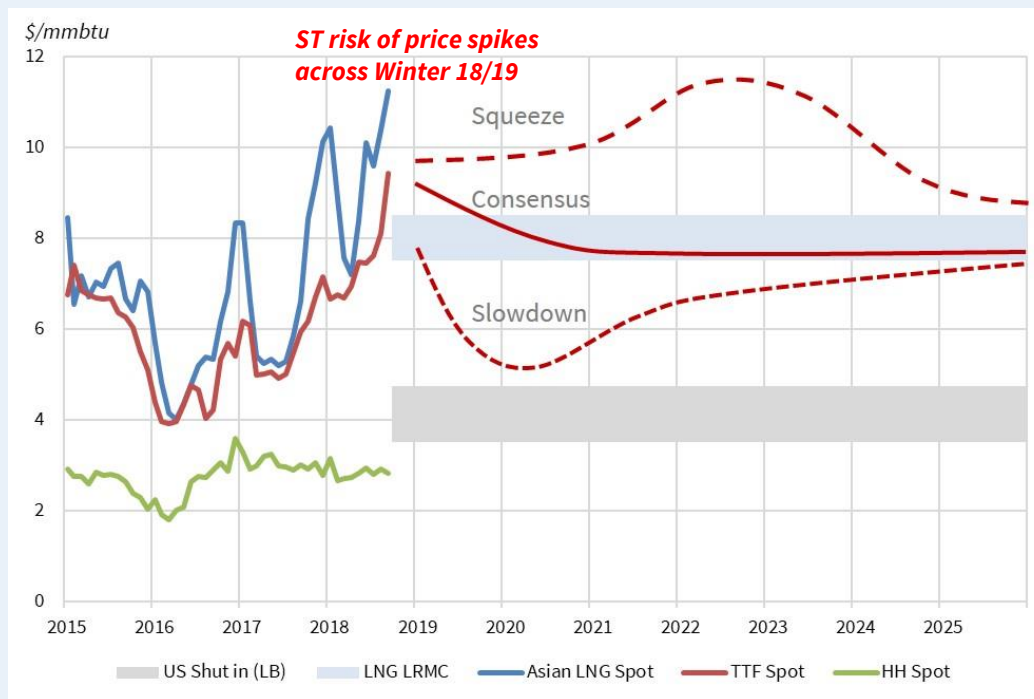
2. Squeeze

- Strong Asian demand growth + ramp up delays/issues with new LNG supply
- Price squeeze 2022-25 as demand outstrips supply. Prices above LRMC.

3. Slowdown

- Slowdown in Asian demand means supply outstrips demand 2019-21 (e.g. recession).
- Surplus LNG 'spills' into European hubs depressing prices, which gradually revert to LRMC levels as market rebalances.

3 potential paths for European hub price evolution



Source: Timera Energy

- Key linkage between European & Asian gas markets going forward given 100+ mtpa of flexible (price responsive) LNG supply that can arbitrage structural price differences.
- Asian spot LNG prices are not shown but likely to remain strongly linked to TTF, albeit with significant volatility given inherent LNG supply chain response time constraints.
- LRMC of marginal new LNG supply assumed to be in a 7.5 – 8.5 \$/mmbtu range. Any increase in Henry Hub prices above 4 \$/mmbtu would place upside pressure on LRMC range.
- Grey shaded area shows price support range from reducing US LNG supply via shut ins.
- Note: price paths are illustrative and should not be interpreted as Base/High/Low scenarios.

Evolution of supply flex price signals

Tightening market → rising flex value

3 key drivers supporting recovery in supply flex value

1. Rising import dependency (e.g. supply chain delays)
2. Power intermittency (gas plants key swing providers)
3. Lack of investment (low capex spend last 5 yrs)

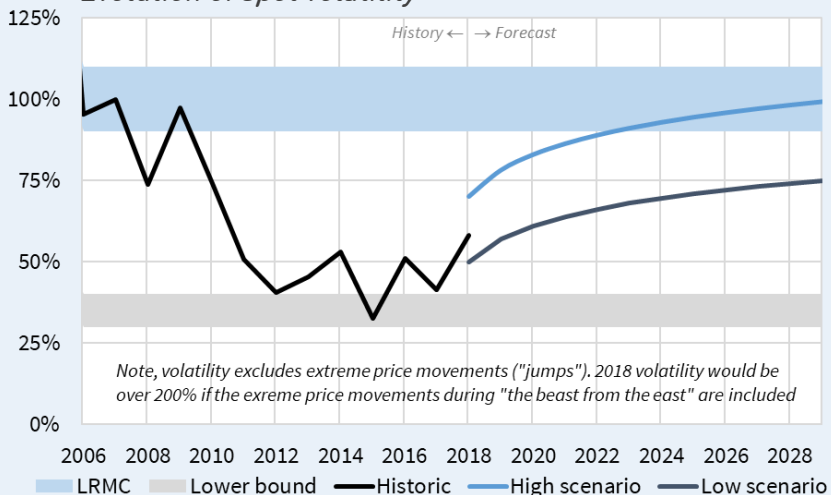
Volatility drivers

- Inelastic ST supply in Europe & Asia → spot volatility
- TTF % vol rising in 2018, but also acting on higher prices
- Shocks becoming larger & more frequent (ref 1. & 3.)

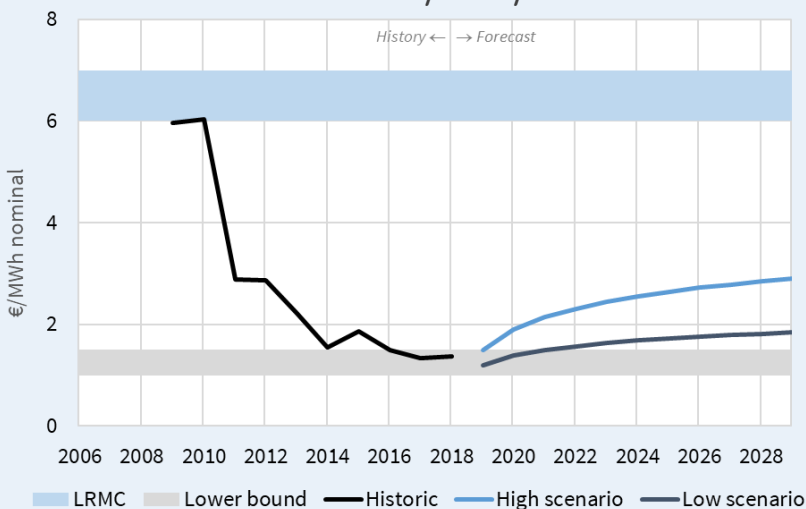
Seasonal spread drivers

- Seasonality in Russian / LNG flows declining 2017-18 + Europe providing seasonal LNG flex to Asia
- UK spread recovery (post Rough) drawing Norwegian flex
- Forward price spreads remain low, but value may increasingly be realised in prompt (i.e. within-years)

Evolution of spot volatility



Evolution of TTF seasonal price spreads



Source: Timera Energy

Commercial challenges

Market drivers

Summarised on previous slides

1. **Tightening gas market:** European (& Asian) gas market risk shifting from 'oversupply' (2019-21) to 'deficit' (2022-25).
2. **Growing importance of LNG:** Europe's role as swing provider to LNG market increasingly important in driving TTF price dynamics.
3. **Rising power market linkage:** Switching impact on gas demand key to TTF pricing. Growing flex requirement from power sector (intermittency).
4. **Russian market power:** Tighter market is strengthening role of Russia as 'supplier of the marginal molecule', i.e. pricing power.
5. **Tightening supply flex balance:** Low investment, rising import dependency & power sector swing are eroding flex overhang. Flex value shifting to prompt (e.g. capture of volatility).

Commercial challenges

Summarised on following slides

A. Value Capture

'How do I maximise value capture from my existing assets, while managing risks?'

B. Portfolio Construction

'Given changing role of gas, how do I structure my portfolio to grow value and manage risk?'

C. Asset investment (develop/acquire/divest)

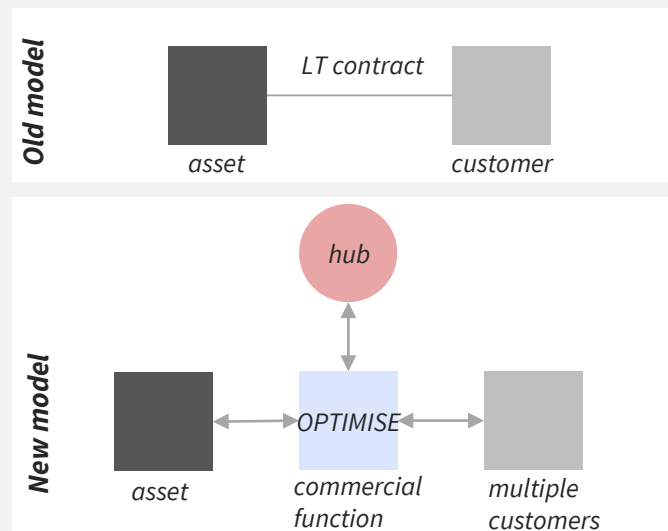
'How do I identify value, quantify risk/return & define marginal impact of asset on my portfolio?'

Challenge A: Value capture

5 trends impacting gas asset value capture

	Trend	Impact
1	Value shifting to prompt	Structural shift in asset value closer to delivery (e.g. vol capture). Harder to hedge value forward.
2	'Shock' value rising	Import dependency → Shocks. Shocks becoming larger & more frequent (e.g. beast from east).
3	LT contracts rolling off	Changing asset risk/return. Double challenge = monetise exposure + protect legacy LTCs.
4	Flex value recovering	Higher gas prices → greater value from volatility. Position assets/contracts for further recovery.
5	Optimisation creating value	Mkt evolution creating value opportunities from 'commercially sweating' assets (see table).

Value capture models (e.g. pipes, storage, regas)



5 ways to boost midstream asset value

- 1. Optimise asset variable costs** (i.e. reduce cost hurdle to capture value)
- 2. Optimise asset supply chain** (e.g. entry/exit, maintenance, fuel gas, linepack)
- 3. Retain asset flexibility into prompt** (i.e. capturing vs selling out flex value)
- 4. Use hubs to enhance asset flex & services** (i.e. de-link services from physical asset)
- 5. Broaden/refine capacity product offering** (e.g. customer netting, virtual products)

Challenge B: Portfolio construction

5 trends impacting gas portfolio construction

	Trend	Impact
1	De-carbonisation	Structural role of gas into 2040s. But focus/value of gas portfolios to evolve with energy transition.
2	Rapid growth of LNG	Rapidly expanding supply & liquidity. Key source of growth and diversification for gas portfolios.
3	Power sector linkage	Increasing gas / power market dependencies. Rising power sector demand for gas supply flex.
4	From LTCs to trading	Erosion of LT contracts & shift of value to prompt is increasing trading importance & returns.
5	Refocusing in supply chain	Portfolio strategies being driven by refocusing within supply chain (see examples to right).

Gas portfolio evolution: 4 case studies



Shell

*Expand & diversify**

- **Power:** acquire retail & generation (e.g. First Utility, Inspire, Axiom)
- **LNG:** expand supply & trading portfolio (e.g. BG, Shell Canada, Hazira India)



Equinor

Rebrand & diversify

- **Power:** 20% capex on renewables by 2030 (offshore wind key e.g. Arkona, Dogger Bk)
- **Trading:** expand gas & power trading (e.g. acquisition Danske Commodities)



Uniper

Split & expand

- **Trading:** Expand across regions & markets (e.g. US & coal desk expansion)
- **LNG:** expand supply & trading portfolio (e.g. Woodside/Pavilion deals, DE regas)



Engie

Divest & refocus

- **Sales:** cut supply chain & regional footprint (e.g. upstream & thermal power sales)
- **Services:** refocus on core infra & services (e.g. grow energy services – Evbox, EPS)

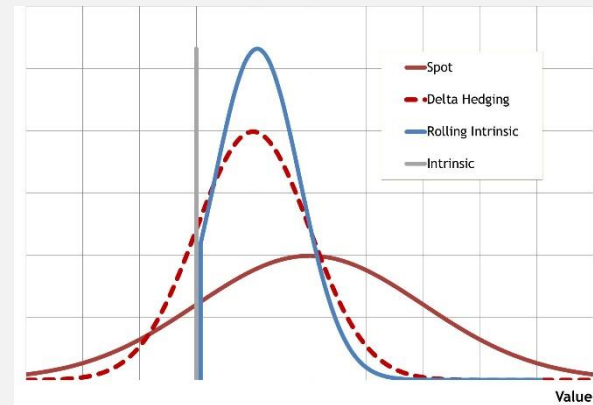
*Total following similar strategy

Challenge C: Asset investment

5 trends impacting gas asset investment

	Trend	Impact
1	Gas market tightening	Value of upstream projects/reserves rising. Value of midstream supply flex increasing.
2	LT contract challenge	LTCs rolling off that can't be replaced (at same terms) → increasing market exposure of assets.
3	Value shift to prompt	Asset flex value capture shifting nearer to delivery. Investors need to quantify & manage this.
4	Risk/ return profile shift	Combination of 1. 2. & 3. is increasing gas asset returns, but also asset risk distributions.
5	Buyer competition	Low level of buyer competition to buy gas assets with merchant exposure (vs e.g. power sector).

Asset valuation



Quantifying asset value requires probabilistic modelling analysis that captures asset risk/return distribution and impact of contracting strategy.

5 drivers of gas asset valuation

- 1. Utilisation** Evolution of supply volumes, routes and flow patterns drive capacity utilisation
- 2. Constraints** System constraints, both physical & contractual, drive capacity value premia
- 3. Flex value** Interaction between physical asset flex & market price signals drives extrinsic value
- 4. Liquidity access** Access to liquid hub price signals drives ability to monetise capacity value
- 5. Risk/return** Ability to quantify asset risk/return distributions & price market risk is a key differentiator between investors (see diagram)

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



PetroChina



J.P.Morgan





What do we do?

1. Market analysis

Unique integrated global LNG, European gas & power market models

- Europe/global supply & demand balance analysis
- Projections of hub prices, seasonal spreads & volatility

2. Asset valuation

Leading edge stochastic asset valuation models (widely used by investors)

- Valuing pipes, regas storage, LNG flex
- Intrinsic & extrinsic margin analysis of flex midstream assets

3. Value capture

Extensive practical industry experience of monetising asset value

- Asset hedging & optimisation
- Capacity sales strategy & asset contracting
- Analytical tools

4. Transaction support (buy side)

Strong track record supporting buyers/investors in European midstream gas asset transactions

- Pre-acquisition: Market & margin modelling (1. & 2. above) + transaction due diligence support
- Post acquisition: Hedging strategy, contract structuring, value chain optimisation, analytic tools (3. above)

Who do we work with?



1. Market analysis

Oil major

Evolution of global LNG market balance & impact on NBP/TTF pricing dynamics.

Storage operator

Projection of TTF price spreads & volatility & impact on capacity sales strategy.

2. Asset valuation

Fund

Analysis of value & investment opportunities across multiple European storage assets.

Developer

Commercial advisor to developer of a UK fast cycle storage & LNG regas project

3. Value capture

Utility

Advice on pipeline capacity sales strategy, product structuring & capacity value.

LNG producer

Advice & analytical tool development to support LNG portfolio hedging

4. Transaction support (buy side)

Fund

Commercial advisory & due diligence to support purchase of storage portfolio.

Oil major

Commercial & valuation support for European regas terminal bid.

Fund

Valuation analysis to support large Central European pipeline transaction.

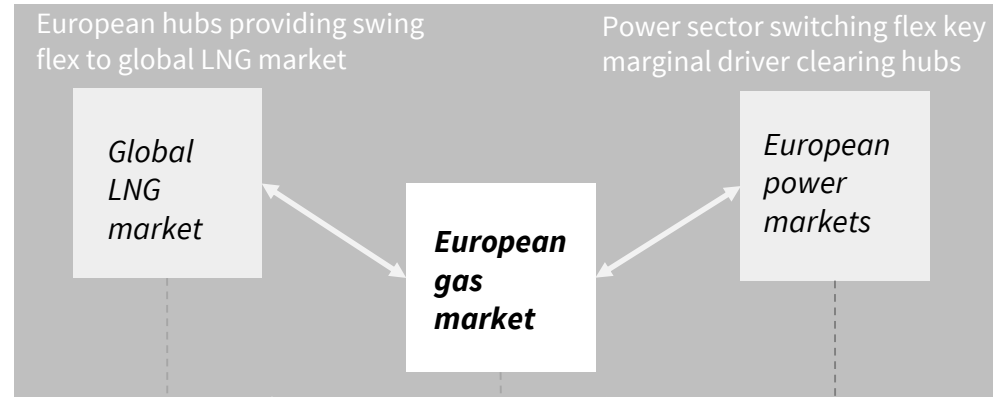


How do we model markets?

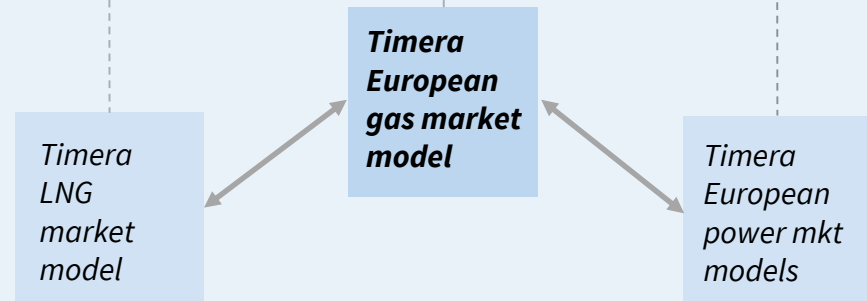
European gas market evolution over next decade will be shaped by interaction with:

- LNG market: growing price/volume impact of swings in LNG imports.
- Power market: greater role of gas/coal switching as mechanism setting hub prices.

Key intermarket relationships driving European gas market



Timera gas market modelling framework



The material in this pack draws on data & analysis from Timera's integrated European gas market modelling framework.

Our gas market model is integrated with our global LNG and European power market models.

"Gas market forecasts will by definition be wrong. The value of market analysis is understanding how."

Timera Energy key team members

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

Olly Spinks

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

Howard Rogers

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

Sonia Youd

*25+ years of energy industry experience.
Expert in gas commercialisation, regulation and trading.
Commercial Director for Centrica Storage.*

David Stokes

*20+ years energy/commodity market experience
Expert in value/risk management of flexible assets
Industry roles with Origin, Williams, JP Morgan*

Nick Perry

*30+ years industry experience (Amoco, Exxon, Enron)
Expert in commercial & risk management strategy
Board level experience (Enron Europe, Teesside Power)*

Henry Crawford

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



Olly Spinks
Managing Director

olly.spinks@timera-energy.com
+44 (0) 7525 724 461

David Stokes
Managing Director

david.stokes@timera-energy.com
+44 (0) 7957 656 337

Address: 110 Bishopsgate, London, EC2N 4AY, UK
Tel: +44 (0) 207 961 0805

www.timera-energy.com

 **TIMERA**
ENERGY