European gas market in transition
Market drivers & commercial implications
Oct 2018

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### Disclaimer

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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.

Source: Timera Energy
European supply & demand balance

What is driving hub prices?

3 key factors driving marginal pricing:

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

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.

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+ bcma 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.

3 Asia/TTF spread states drive flow dynamics

<table>
<thead>
<tr>
<th>State</th>
<th>Spread range</th>
<th>Flow dynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Converged</td>
<td>0.0 – 0.5 $/mmbtu (grey)</td>
<td>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.</td>
</tr>
<tr>
<td>Ranging</td>
<td>0.5 – 1.5 $/mmbtu (blue)</td>
<td>Asian requirement for incremental LNG supply. Flex supply diverted from Europe to balance LNG market. Reloads viable towards top of this spread range.</td>
</tr>
<tr>
<td>Diverged</td>
<td>1.5+ $/mmbtu (red)</td>
<td>Temporary constraints in LNG supply chain to meet Asian demand. Higher prices required to incentivise diversion of less flex cargoes &amp; higher cost reloads.</td>
</tr>
</tbody>
</table>

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:
  1. **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.
  2. **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.
Key driver 3: Russian flows

Role of flexible Russian gas

- 2 key sources of annual flex in Russian flows:
  1. **LT contracts**: Suppliers have flex to nominate higher volumes (Max ACQ to Take or Pay).
  2. **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).

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*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

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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.

- 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.

- 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)
Commercial challenges

Market drivers
Summarised on previous slides


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

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

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

Old model

<table>
<thead>
<tr>
<th>asset</th>
<th>LT contract</th>
<th>customer</th>
</tr>
</thead>
</table>

New model

<table>
<thead>
<tr>
<th>hub</th>
<th>asset</th>
<th>commercial function</th>
<th>multiple customers</th>
</tr>
</thead>
</table>

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

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

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

<table>
<thead>
<tr>
<th>Trend</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. LT contract challenge</td>
<td>LTCs rolling off that can’t be replaced (at same terms) → increasing market exposure of assets.</td>
</tr>
<tr>
<td>3. Value shift to prompt</td>
<td>Asset flex value capture shifting nearer to delivery. Investors need to quantify &amp; manage this.</td>
</tr>
<tr>
<td>4. Risk/return profile shift</td>
<td>Combination of 1. 2. &amp; 3. is increasing gas asset returns, but also asset risk distributions.</td>
</tr>
<tr>
<td>5. Buyer competition</td>
<td>Low level of buyer competition to buy gas assets with merchant exposure (vs e.g. power sector).</td>
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</table>

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*
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

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil major</td>
<td>Evolution of global LNG market balance &amp; impact on NBP/TTF pricing dynamics.</td>
</tr>
<tr>
<td>Storage operator</td>
<td>Projection of TTF price spreads &amp; volatility &amp; impact on capacity sales strategy.</td>
</tr>
</tbody>
</table>

### 2. Asset valuation

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fund</td>
<td>Analysis of value &amp; investment opportunities across multiple European storage assets.</td>
</tr>
<tr>
<td>Developer</td>
<td>Commercial advisor to developer of a UK fast cycle storage &amp; LNG regas project</td>
</tr>
</tbody>
</table>

### 3. Value capture

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility</td>
<td>Advice on pipeline capacity sales strategy, product structuring &amp; capacity value.</td>
</tr>
<tr>
<td>LNG producer</td>
<td>Advice &amp; analytical tool development to support LNG portfolio hedging</td>
</tr>
</tbody>
</table>

### 4. Transaction support (buy side)

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fund</td>
<td>Commercial advisory &amp; due diligence to support purchase of storage portfolio.</td>
</tr>
<tr>
<td>Oil major</td>
<td>Commercial &amp; valuation support for European regas terminal bid.</td>
</tr>
<tr>
<td>Fund</td>
<td>Valuation analysis to support large Central European pipeline transaction.</td>
</tr>
</tbody>
</table>
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.

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)
European gas market: key drivers

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