North Africa Can Reduce Europe's Dependence on Russian Gas by Transporting Wasted Gas Through Existing Infrastructure

Mark Davis

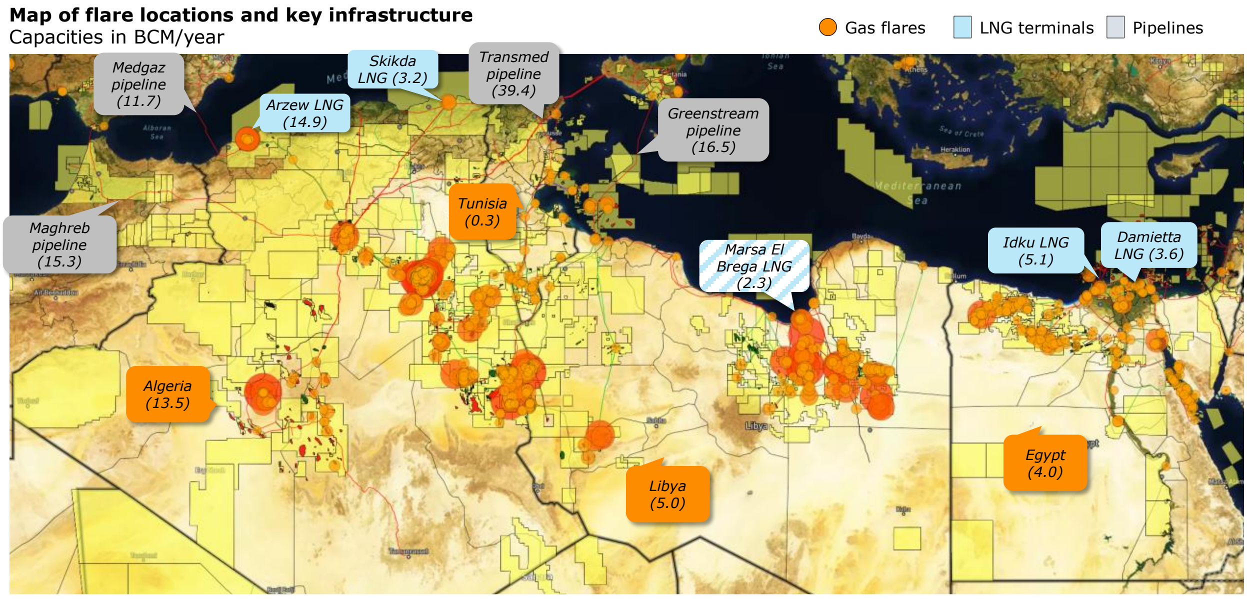
Perrine Toledano

Thomas Schorr

Columbia Center on Sustainable Investment
A JOINT CENTER OF COLUMBIA LAW SCHOOL AND THE EARTH INSTITUTE, COLUMBIA UNIVERSITY

capterio

North Africa can reduce Europe's dependence on Russian gas by transporting wasted gas through existing infrastructure.



Source: Capterio FlareIntel Pro which integrates data from the Colorado School of Mines; World Bank; IEA; https://transparency.entsog.eu/; Literature searches

Russia's war against Ukraine is a wake-up call to reduce Europe's dependence on Russian oil, gas, and coal. It is also a defining moment to accelerate the energy transition to a net-zero society with more supply diversity, energy security, and resilience. Europe needs to massively invest in a cleaner energy system. In the short term, this crisis should accelerate our focus on reducing waste gas from flaring, venting, and leaking – some 260 billion cubic meters (BCM) globally or 1.7x that of the European Union's gas imports from Russia. By capturing gas from flaring, venting, and leaking in North Africa, Europe could, within 12-24 months, start to substitute up to 15% of Russian gas via highly underutilized pipelines and liquified natural gas (LNG) terminals in the region. By capturing this wasted gas, Europe and North African nations can significantly reduce CO2-equivalent emissions without delaying the energy transition and greatly benefit from new revenue streams to reinvest in clean energy sources. We have been talking for decades: it's now time to act.

By Mark Davis (Capterio[1]), Perrine Toledano and Thomas Schorr (Columbia Center on Sustainable Investment[2] at Columbia University) | 29 March, 2022 | 3600 words

[1] www.capterio.com; mark.davis@capterio.com
[2] https://ccsi.columbia.edu/; ptoled@law.columbia.edu and tws2128@columbia.edu

Europe must reduce its dependency on Russian gas while reducing the carbon intensity of its gas imports

Europe's dependency on Russia is vast. In 2021, imports were 155 BCM of gas[3] (by pipe, plus LNG), 880 million barrels of oil and condensate, and 76 million tonnes of coal per year. At recent prices (of $30-40 per mmbtu[4], $100 per barrel and $300 per tonne, respectively), this is over $840 million per day. Moreover, Russian hydrocarbons have some of the world's highest carbon intensities due to the scale of their supply-chain emissions from flaring, venting and leaking gas[5].

In its REPowerEU plan, the EU has set a bold objective to reduce its consumption of Russian gas by two-thirds[6] before the end of 2022. As Ursula von der Leyen put it last week, "*we want to diversify away from Russia towards suppliers that we trust, that are our friends and are reliable*"[7]. The EU is already working to address both the demand and supply sides of its energy system, with full support from a range of international players and allies, including the United States (US) government[8].

Options to reduce fossil gas demand include energy efficiency and wider electrification, particularly for heating. On the supply side, options include substituting with clean fuels such as green hydrogen and biogas, but also increasing LNG and piped gas from Norway, the Caspian and North Africa. However, as the Oxford Institute for Energy Studies commented in its recent paper[9], "*achievement of the [EU] seven-point plan looks extremely challenging*".

Until now, however, no report has looked into capturing wasted gas from flaring, venting and leaking to help meet Europe's objectives[10]. The good news is that these objectives can be achieved without significant investment in new gas exploration or infrastructure, both of which could delay the energy transition.

We must not overlook the world's biggest underappreciated "supply source": wasted gas from flaring, venting, and leaking[11] within the oil and gas supply chain[12]. Flaring, venting, and leaking account for 260 BCM of gas per year – some 1.7x the gas imported by Europe from Russia, or 7% of global gas consumption (see Figure 1).

---

[3] https://www.oxfordenergy.org/publications/the-eu-plan-to-reduce-russian-gas-imports-by-two-thirds-by-the-end-of-2022-practical-realities-and-implications/ and https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1511.

[4] Million British Thermal Units (mmbtu).

[5] https://rmi.org/which-gas-will-europe-import-now-the-choice-matters-to-the-climate/.

[6] https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1511.

[7] As stated at the press conference on March, 25th, following an announcement securing more US LNG to Europe.

[8] https://www.whitehouse.gov/briefing-room/statements-releases/2022/03/25/fact-sheet-united-states-and-european-commission-announce-task-force-to-reduce-europes-dependence-on-russian-fossil-fuels/.

[9] https://www.oxfordenergy.org/publications/the-eu-plan-to-reduce-russian-gas-imports-by-two-thirds-by-the-end-of-2022-practical-realities-and-implications/.

[10] A short article was published on 2 March by Capterio/FlareIntel https://flareintel.com/insights/why-the-war-in-ukraine-must-increase-the-urgency-to-solve-gas-flaring.

[11] "Flaring" is the deliberate combustion of natural gas, "venting" is the known/intentional release of methane e.g., from vents, valves and tanks and "leaking" is the accidental release of methane in pipelines and wells.

[12] Columbia's Centre of Sustainable Investment outlined a range of policy measures on the utilization of associated gas in its 2016 paper, https://ccsi.columbia.edu/content/policy-framework-approach-use-associated-petroleum-gas.

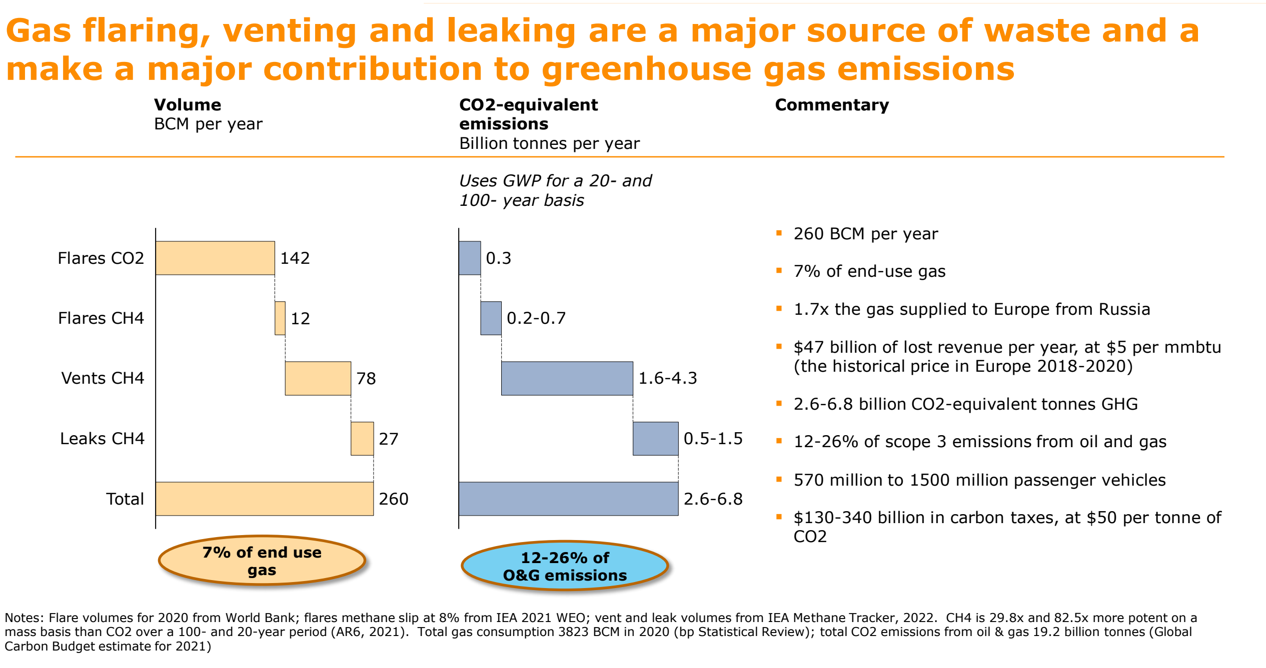


Figure 1: An overview of the scale of the wasted gas from flaring, venting and leaking globally; 260 BCM per year. The resulting emissions are up to 6.8 billion CO2-equivalent tonnes of greenhouse gases. Flaring data is from the World Bank[13], and venting and leaking data is from the IEA Methane Tracker 2022[14]. We use a 92% combustion efficiency assumption, consistent with the IEA World Energy Outlook, 2021[15] and a Global Warming Potential (GWP) of 29.8 and 82.5 for a 100- and 20-year period, respectively, from the IPCC AR6 report. Total emissions from the oil and gas sector, or 19.2 billion tonnes of CO2 are 2022 estimates from the Global Carbon Budget[16].

Put differently, flaring, venting, and leaking amount to up to 6.8 billion CO2-equivalent tonnes of greenhouse gas emissions (the equivalent emissions from up to 1.5 billion passenger vehicles), $47 billion in lost revenue per year[17], and up to $340 billion in potential carbon taxes[18].

Fortunately, there is increasing international attention on this issue. Indeed, in early March, the Oil and Gas Climate Initiative said "*virtually all methane emissions can and should be avoided*"[19], and its members have committed to putting in place "*all reasonable means to avoid methane venting and flaring*".

---

[13] https://www.worldbank.org/en/programs/gasflaringreduction/global-flaring-data.
[14] https://www.iea.org/reports/global-methane-tracker-2022.
[15] https://www.iea.org/reports/world-energy-outlook-2021.
[16] https://www.globalcarbonproject.org/carbonbudget/.
[17] At the average Dutch Title Transfer Facility (TTF) gas prices in the pre-crisis period 2018-2020.
[18] At $5.0 per mmbtu (the average price of gas in Europe TTF hub was EUR 15.5 per MWh for 2018-2020 inclusive) and $50 per tonne of CO2e.
[19] https://www.ogci.com/ogci-members-aim-to-eliminate-methane-emissions-from-oil-and-gas-operations-around-2030/.

By reducing its gas flaring, venting and leaking, North Africa can monetize currently wasted gas, plus reduce the carbon intensity of its exported gas

Some of this wasted gas is on Europe's doorstep, in Algeria, Libya, Tunisia and Egypt. These North African countries waste 23 BCM of gas per year from flaring, venting and leaking (equivalent to 15% of Russian gas imports into the EU). At gas prices representative of the period between 2018 and 2020 ($5 per mmbtu), capturing this waste gas could amount to revenues of $4.1 billion per year (or $140 per second). However, at today's prices, revenues could be closer to $29 billion per year[20] (or $916 per second). Moreover, capitalizing on this economic opportunity could reduce greenhouse gas emissions in these countries (by 86% based on a first-principles calculation, from 466 million to 67 million CO2-equivalent tonnes per year[21]) and reduce air pollution.

The chart below shows the volume of gas being flared, vented and leaked by country (left), and highlights the fields within those countries with the largest flaring volumes (right).

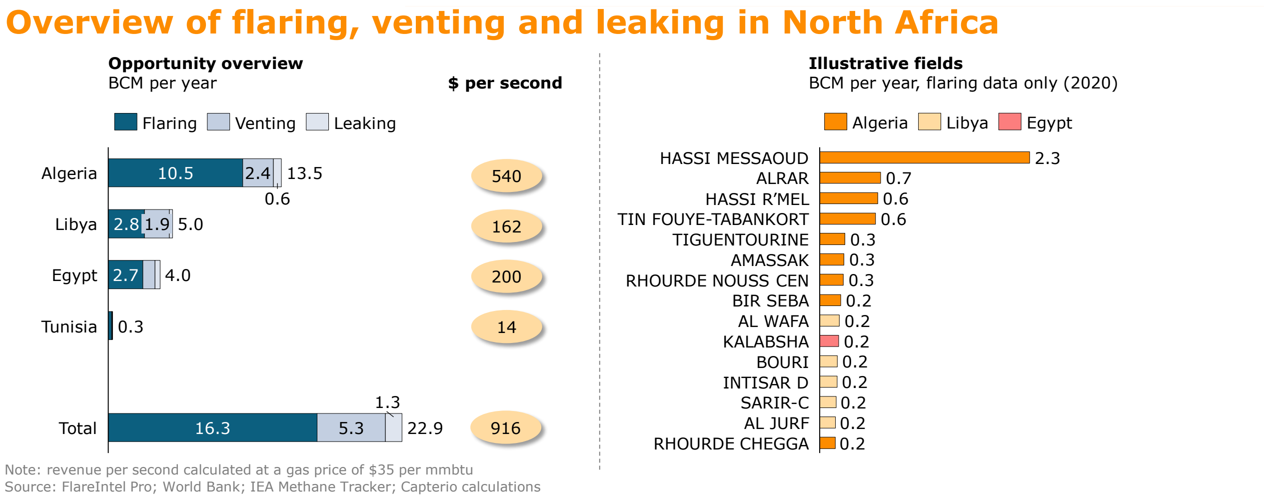


Figure 2: breakdown of flaring, venting and leaking by country (left) and the largest flare capture opportunities by oil/gas field and country (right). Note flares in 2022 are broadly similar.

There are three main reasons why flaring remains at elevated levels today. Firstly, a lack of flaring data, its visibility, and enforcement by regulators has not put the issue firmly "on the radar" of producers and governments. Secondly, there have been challenges – perceived or otherwise – around the economics of capturing flared gas. Thirdly, there has been a lack of capital investment and technical capabilities to identify, define and execute these projects. Today, however, an increasing set of service

---

[20] For all backup calculations, please see this calculation sheet.

[21] We use a 20-year Global Warming Potential for methane, meaning that methane is 82.5x more potent than CO2 as a climate-forcing agent, over a 20-year period. See calculation sheet for details. Also of important note: whilst we of course assume that the gas is still ultimately combusted, producing emissions, there are two reasons why the emissions dramatically reduce. Firstly, the gas currently vented and leaked (producing CH4) is combusted (producing CO2), and CO2 is less potent as a GHG than CH4. Secondly, the combustion efficiency of the eventual combustion process can be dramatically increased (from an assumed value of 92% today, to an assumed 98% when transported to, and combusted in an efficient CCGT plant), also lowering their CO2-e emissions.

companies are bringing deep flare/vent/leak expertise to the market, and institutional investors are increasingly interested in combining third-party capital with innovative commercial models.

This paper shows how we can build on the momentum of these positive changes to end venting, leaking and flaring in North Africa in the context of the European energy crisis. Most critically, flare projects do not require additional investment in exploration to find new resources (as opposed to some of the other efforts presented by the EU). Indeed, according to the IEA's latest methane tracker[22], "*over 40% of methane emissions from oil and gas operations could be avoided at no net cost as the outlays for the abatement measures are less than the market value of the additional gas that is captured*".

Algeria, Tunisia, Libya and Egypt can play a pivotal role here – whilst also creating a "win" for themselves – by reducing the carbon footprint of their own industry, improving air quality, generating much-needed revenues and improving their country's attractiveness for further investment, both foreign and domestic. Efforts to reduce flaring, venting and leaking should therefore be a strategic and diplomatic focus of the European Union and its allies, and a major social and economic opportunity for North Africa.

Why flare capture projects are attractive, low carbon intensity, gas options in North Africa

Specifically zooming into gas flaring, we see tremendous opportunities in Algeria, Libya, Egypt, and Tunisia. Flares here are not only moderate to large in scale: indeed, 88% of flared volume are from flares >0.02 BCM per year (2 million standard cubic feet per day), but also continuous in nature[23].

Many of these flares can be mitigated with proven technology, with gas capture to pipelines often being a viable economic solution. In fact, within these North African countries, our analysis finds that 76% of the flared gas (some 12.4 BCM) lies within 20 km of existing gas pipelines, and 57% of the flared volume is within 10 km of an existing gas pipeline[24]. Since many of the pipelines in North Africa have spare capacity (see below), we believe that many commercially attractive projects can be delivered, especially if a clear roadmap is defined.

To give a specific example, we illustrate in Figure 3 a flare capture project from Algeria that recovers gas from several significant flares using existing infrastructure. Capterio's detailed evaluation identified that by installing 6 gas compressors and 18 km of additional gas trunklines, the 0.4 BCM of flared gas per year (40 million scf/day), as determined by Capterio's FlareIntel tool, could be captured, processed, transported and monetized through existing pipelines that lead to Europe. Capturing this gas would reduce CO2-equivalent emissions by 52%, or 1.3 million CO2-equivalent tonnes per year[25]. Moreover,

---

[22] https://www.iea.org/reports/global-methane-tracker-2022/strategies-to-reduce-emissions-from-fossil-fuel-operations#abstract.

[23] According to analysis by Capterio on data from FlareIntel, which maps the proximity of every gas flare to every gas pipeline. The character of flares in this region is quite different to those, for example, in the US. Whilst flaring in the US is large in absolute scale (12 BCM in 2020), the flares tend to be small in scale, and therefore, tend to be more challenging to resolve commercially.

[24] According to an analysis by Capterio which calculates the distance from every flare to every gas pipeline.

[25] See calculations in this google sheet.

should additional gas be used to generate power to displace coal-based electricity the emissions versus the current state could be reduced by 72%[26].

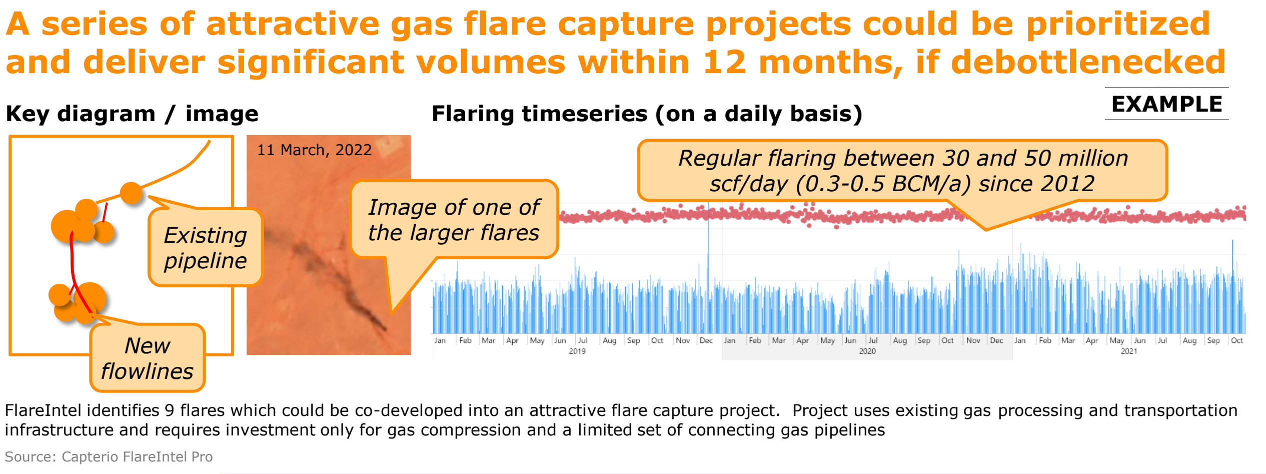


Figure 3: Sanitized illustration of an attractive flare capture project in Algeria. This field consistently flares between 0.3-0.5 BCM per year (30 and 50 million scf/day) and yet could be integrated into the existing pipeline network (which has spare capacity) for modest capital investment.

This project would generate revenue of $80 million per year at "old" prices of $5 per mmbtu (or $570 million at today's prices of $30-40 per mmbtu)[27]. According to a detailed conceptual engineering study conducted by Capterio, a total capital investment of not more than $50 million (i.e., a little over $1 million of capital per million scf/day) is needed to add equipment to separate and compress the gas and install 20 km of additional gas trunk lines.

This project also has a low unit development cost ($0.60 per mmbtu on a levelized basis[28]), in part because it relies on nearby facilities that are currently underutilized. We do, however, note that some investment may also be required at the processing facility, depending on the precise gas composition. This project example could be delivered within 6-9 months *if the project were to be fast-tracked with the dedicated support of the government and its National Oil Company, appropriate commercial agreements in place, and minimal bureaucratic or supply-chain delays*. When operating costs are included, projects like this can deliver pre-tax payback within 1-2 years at "old" prices of around $5 per mmbtu with attractive double-digit-plus post-tax commercial returns.

With gas prices expected to be above historical averages for several years (due to lower capital investment and constrained credit markets since 2014, strong post-COVID recovery, a tight global oil and gas supply chain, and a desire to diversify from Russian gas), we can expect the economics for many such projects to be especially attractive.

[26] See Capterio's paper: https://flareintel.com/insights/how-a-focus-on-gas-flaring-at-cop26-can-accelerate-decarbonisation.
[27] See live data at https://tradingeconomics.com/commodity/eu-natural-gas.
[28] We assume a 5% flare decline rate and a 10% cost of capital. To calculate the levelized unit capex, we divide the discounted capex cost by the discounted volume.

Several similar flare capture projects have been delivered in recent years[29]. Informed by a range of detailed engineering studies conducted by Capterio, our rough estimate is that up to ½ of the potentially recoverable gas of 23 BCM could be captured within a total budget of $1.5-4 billion in capital investment.

In addition to bringing natural gas to market via existing pipeline infrastructure, as discussed above, there are a range of other solutions worth addressing, although some are more conducive to promoting the energy transition than others. Other solutions for flared gas capture include: (a) generating power for local industrial operations, (b) reinjecting the gas for disposal or storage, (c) using the gas for enhanced oil recovery (EOR) projects, (d) transporting the gas to market via a "virtual pipeline" (of trucks) in the form of compressed natural gas (CNG) or LNG, or: (e) other more "exotic" solutions such as cryptocurrency mining (although many argue that this is one of the least environmentally productive uses of flared gas). Capterio's research has highlighted several case examples that cover this range of solutions[30].

Producers, however, cannot solely rely on using the gas for power generation or EOR to fully mitigate flare gas for primary two reasons. Firstly, there is usually insufficient demand for power at oilfield operations to consume all of the flare gas. Secondly, solutions such as EOR need careful consideration not only on their technical credentials (not all reservoirs have the right chemistry or capacity to absorb reinjected gas), but also on carbon grounds (as the reduction in flaring needs to be compared against the increased emissions associated with the additional oil production)[31].

North Africa's gas export facilities (pipeline and LNG terminals) have spare capacity today that could transport additional gas to Europe.

North Africa is already well connected to Europe via four operational pipelines and four LNG terminals with a total technical capacity of 110 BCM per year (83 and 29 BCM per year for pipeline and LNG respectively; Figure 4). Major transport infrastructure, therefore, already exists, with large volume capabilities (~63 BCM) and significant spare *export* capacity in both pipelines and LNG terminals (with a weighted average utilization rate of only 42%[32]), especially if a restart is needed[33]; Figure 4.

---

[29] See a recent paper that illustrates projects in Egypt, Algeria, US and Iraq: https://flareintel.com/insights/celebrating-successful-flare-capture-projects-with-independent-data-driven-evidence

[30] See https://flareintel.com/insights/celebrating-successful-flare-capture-projects-with-independent-data-driven-evidence

[31] https://ccsi.columbia.edu/sites/default/files/content/docs/publications/A-policy-framework-for-the-use-of-APG-July-2016-CCSI.pdf.

[32] Only the Medgaz pipeline in 2022 has run close to its maximum capacity.

[33] Flows through the Maghreb pipeline stopped in November 2021 while Libya's LNG terminal has not been operational since 2011.

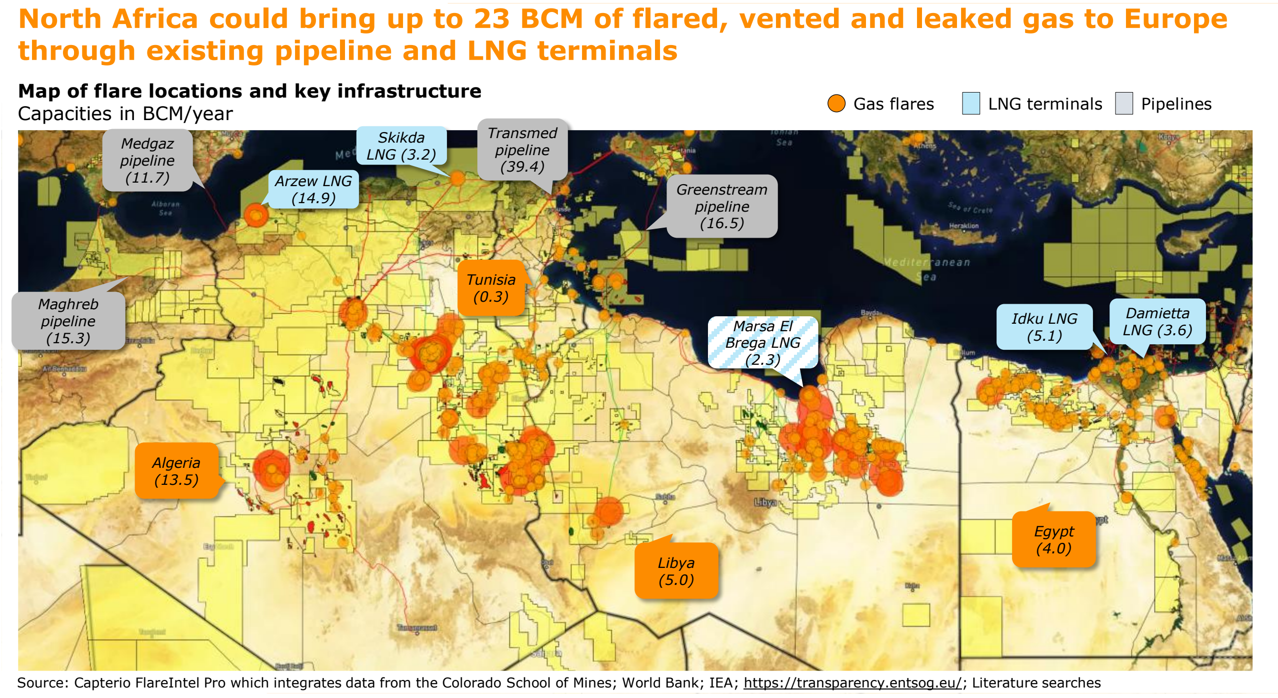


Figure 4: Map showing the location of all gas flares, major pipelines, and LNG facilities and their relative magnitudes in BCM per year. Data from Capterio's flare-tracking tool, FlareIntel Pro.

Regarding pipeline exports: Algeria has a lot of flexibility in the routing of gas export since much of it flows through the major gas hub of Hassi R'Mel. In November 2021, Algeria elected to stop all gas deliveries through the Maghreb pipeline. Ostensibly, this was due to disputes between Algeria and Morocco over Western Sahara (and a recent US-led diplomatic mission[34] to persuade the Algerian government to resupply gas, which was unsuccessful). However, reports suggest that the real reason for the pipeline closure[35] is that Algeria's gas exports have declined due to rising domestic consumption and declining gas production.

Regarding LNG exports, Egypt's LNG plants ran at a combined utilization rate of 50% in January and February 2022. Similarly, Algeria's two LNG terminals had a low combined utilization rate of 37% over the same period, according to analytics company Kpler[36], partly due to issues with a gas compression facility at Skikda. Fortunately, there is significant spare LNG *import* capacity in Europe (as average regasification rates in Europe were 47% in 2021), which could better be utilized if the network were to be optimized[37,38].

---

[34] See https://news.middleeast-24.com/world/84790.html.
[35] https://www.menas.co.uk/blog/the-real-reason-for-algerias-closure-of-the-gme-gas-pipeline/.
[36] Data obtained through conversations with Kpler.
[37] e.g., to utilize the UK as a LNG land bridge sending gas to continental Europe, and if the flows to and from Iberia were optimised through better coordination of the Algeria pipeline, LNG infrastructure and connection to France.
[38] According to analysis by Kpler published in https://www.oxfordenergy.org/publications/the-eu-plan-to-reduce-russian-gas-imports-by-two-thirds-by-the-end-of-2022-practical-realities-and-implications/.

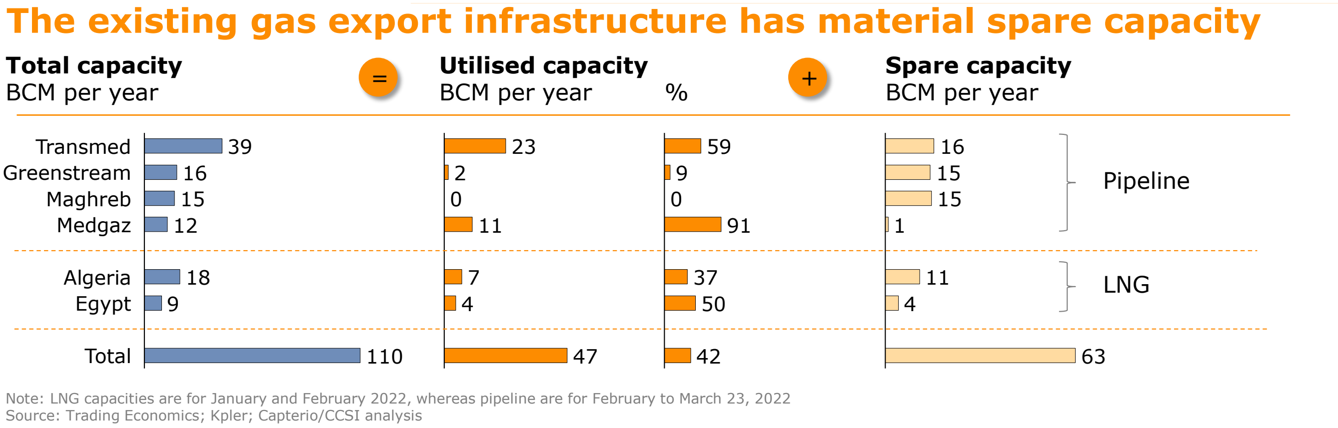


Figure 5: Analysis of the spare capacity in the existing pipeline and LNG export infrastructure. Data derived from ENTSOG.EU and analytics firm Kpler.

In conclusion, North Africa has spare export capacity that could be used to transport additional gas captured from flares, vents and leaks to Europe whilst also generating substantial domestic revenues and enabling them to accelerate their own energy transitions through emission-reducing projects that meet their net-zero targets. Europe should engage these countries at a diplomatic and trade level in order to generate the appropriate political and economic support to facilitate the success of these projects, consistent with their other existing international trade obligations, relationships, constraints, and plans. There is also the possibility that, beyond the recovery of flared, vented and leaked gas, even more gas could be available for export if solar power deployment[39] for domestic consumption was ramped up and energy efficiency initiatives (coupled with subsidy reform) were accelerated.

Without diverting attention from the energy transition, the world must mobilize and lift barriers to enable the recovery of flaring, venting and leaking gas.

Implementing gas capture projects as outlined above can help Europe deliver on its REPowerEU plan without delaying its own energy transition targets. We believe that new investments (from oil companies, banks, and private equity firms) should prioritize gas capture projects that take advantage of capacity in existing pipelines, LNG terminals and gas-to-power plants. Such projects will not only align with global emissions goals, but also address the world's immediate energy needs.

To achieve this, we need radical changes from a range of stakeholders:

- **Regulators** should enforce existing penalties for flaring, venting, and leaking (many of which are already in legislation) on operators who do not meet required operational standards.
- **Governments** should consider incentivizing policies such as carbon taxes and carbon border adjustments[40].
- **Operators** must think more creatively and work across contractual and organizational boundaries where necessary. We need to see tangible commitments and actions from a range

[39] North Africa's solar potential is one of the biggest in the world: *https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2014/IRENA_Africa_Resource_Potential_Aug2014.pdf*
[40] See paper for more details: https://flareintel.com/insights/how-the-eus-cbam-will-impact-energy-imports-from-countries-that-flare-gas.

of National and International Oil Companies, including Algeria's Sonatrach, Egypt's EGPC, and Libya's NOC, plus investment from leading International Oil Companies, which (in the region) include Eni, Equinor, Repsol, OMV, TotalEnergies, bp and Apache. Whilst it is promising to see that many of these companies have endorsed the World Bank's Zero Routine Flaring[41] (by 2030), faster action is needed on flare capture projects[42].

- **Service companies and equipment manufacturers** should figure out business models to rapidly scale their impact and build key equipment.
- **Funding bodies** should mobilize capital for projects that are *confirmed specifically as flare gas capture projects*. Whilst many institutions are moving away from international fossil fuel projects, flare capture projects should be considered as a special case. Financial and engineering analysis should be urgently conducted to identify where operators (in particular the NOCs) should prioritize investments, and where third-party funding from bodies like the European Investment Bank can be most impactful and additional.
- **Consumers** can increasingly offer support by demonstrating a preference for hydrocarbons that are certified to have lower supply-chain emissions.
- **Leadership from** Governments and National and International Oil Companies alike. Above all, each must act with pace. Change must start from the top.

We must use this crisis as a defining moment to grip the challenge of flaring, venting and leaking gas. In doing so, we can generate a credible alternative to Russian gas, reduce emissions and encourage producing countries to use the proceeds to accelerate their own energy transitions.

---

[41] https://www.worldbank.org/en/programs/zero-routine-flaring-by-2030.

[42] More details on these projects are outlined in our paper: https://flareintel.com/insights/celebrating-successful-flare-capture-projects-with-independent-data-driven-evidence.