ETH Zurich Department of Architecture
ARCHITECTURE OF TERRITORY
Chair of Architecture
and Territorial Planning
Professor Milica Topalović

Power to the People
Fall 2022

Atlas

Gas

Filippo Biasca-Caroni, Martin Kohlberger, and Isidor Gonzalez Escobar

While German state leaders have carefully built up the energy supply on the Russian gas over the last century, the news on the interruption of the European gas supply by Russia have put Europe in a state of shock and fear. Triggered by Russia's war in Ukraine, the fragility of Europe's gas supply and especially Germany's dependence on Russian gas is becoming increasingly apparent. Already starting in February this year, following Russia's war on Ukraine and the subsequent EU sanctions—in combination with the world economic impact of Covid19—the European gas prices have spiked. Today, they are more than eightfold the price of what we were used to pay some years ago. In the summer of 2022 many European countries still might have been able to get their hands on gas to fill their gas reserves, but already next year this might become difficult. What does this mean for the gas network and for how heating will evolve?

A GENEALOGY OF THE GAS CRISIS
Source: ZDF Heute, 2022 [https://www.zdf.de/suche?q=gas&from=&to=&attrs=&sender=ZDFheute&sortBy=date&synth=], and Pléiades Neo, Airbus DS, 2022 [https://www.esa.int/ESA_Multimedia/Images/2022/10/Nord_Stream_leak_as_captured_by_Pleiades_Neo#.Y0vNJw-fq10.link]

https://youtu.be/ky1jbacJHbk

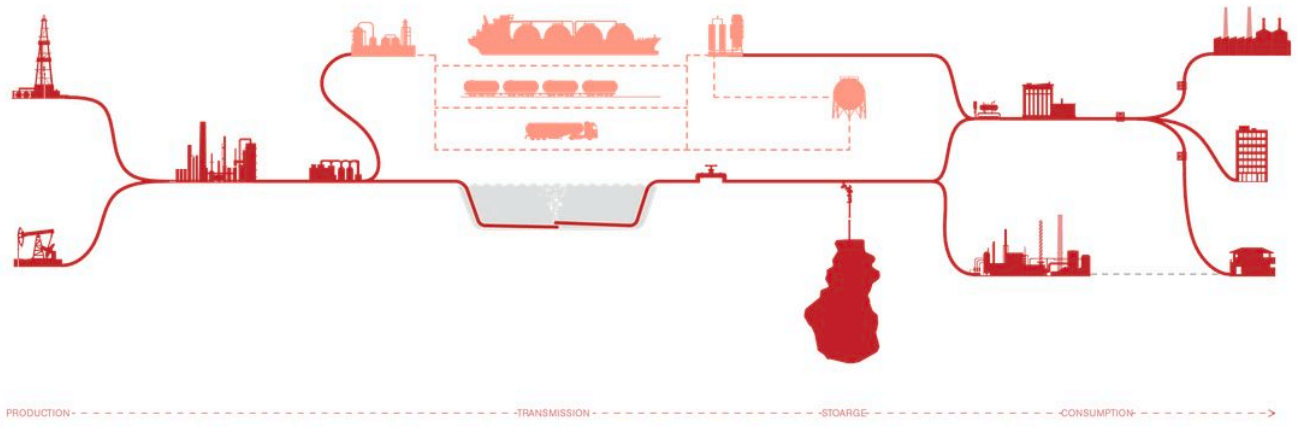
Under Pressure: Gas Supply and National Interests

CONSTRUCTION OF A NATURAL GAS PIPELINE IN ROHR, SWITZERLAND
Source: Comet Photo AG (Zürich), 1973 [https://ba.e-pics.ethz.ch/catalog/ETHBIB.Bildarchiv/r/987357/viewmode=infoview/qsr=Gas%20pipeline]

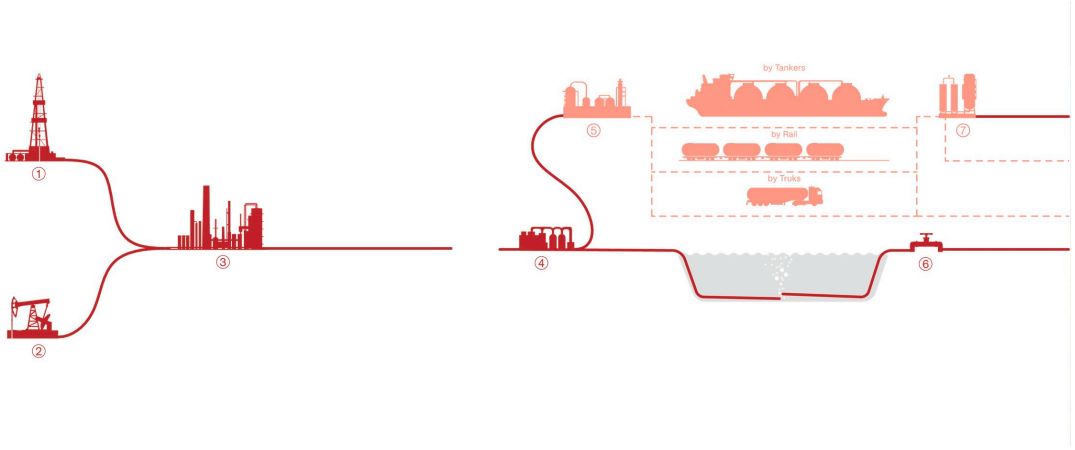
Unlike the global scale of oil markets, the European gas infrastructure is currently a continental interconnected system, with gas flowing from the extraction sites in resource-rich countries such as Russia, Norway or Qatar to our building (Long, 2004). From extraction to consumption, an interruption at a single junction of this interlinked system of pipelines can have major consequences. In order to ensure the flow of gas, the network requires a number of facilities in addition to the pipelines themselves: be it the gas metre in our own building, the so-called city gate, which is responsible for the transfer to the local network, or the compressor stations, which generate a gas pressure of up to 27.5 bar to propel the gas through the transmission pipelines and are arranged approximately 100 kilometres apart. The smaller local lines starting at the city gates and serving the settlements, are working on a much lower pressure.

The national gas supply also includes the much-discussed cavern or pore gas storage facilities. In order to fill them in the upcoming years, recent ideas have popped up to include more terminals and facilities for liquified natural gas (LNG). By that, gas would be made shippable just like oil and would not be bound to the rigid pipeline network anymore. In parallel, there are attempts to import from a more diverse number of supply countries such as Azerbaijan, Qatar, Saudi Arabia, the United Arab Emirates, Algeria, Israel and the USA. But will the solution to the gas crisis be that Germany is now dependent on five partner autocracies instead of one?

GAS INFRASTRUCTURE

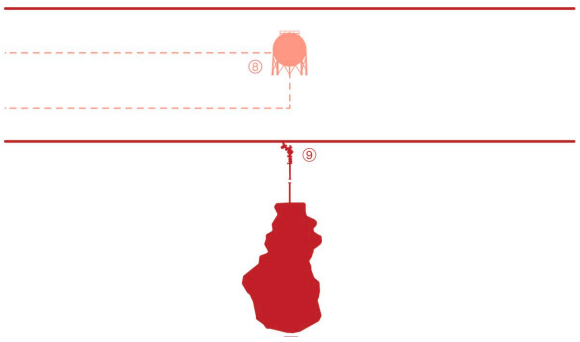


INTERNATIONAL GAS INFRASTRUCTURE

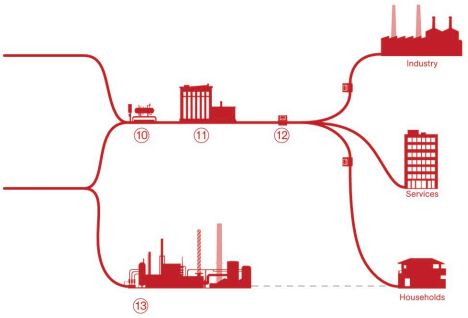


PRODUCTION
1. Gas well, 2. Oil well, 3. Processing plant

TRANSMISSION
4. Compressor station, 5. Liquefaction station, 6. Pipelines, 7. Regasification station



STORAGE
8. LNG storage tank, 9. Underground storage



CONSUMPTION
10. Odorizer, 11. Citygate, 12. Gas meter, 13. Power plant

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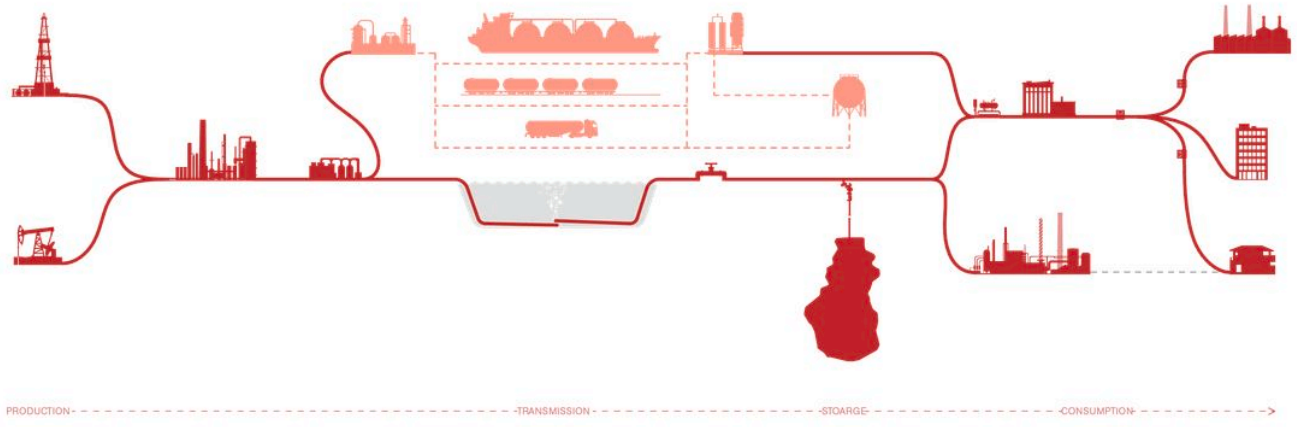

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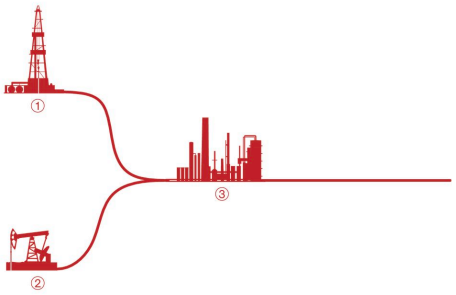

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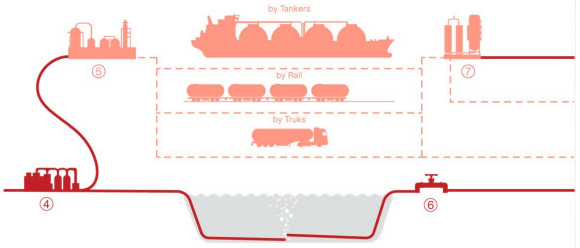

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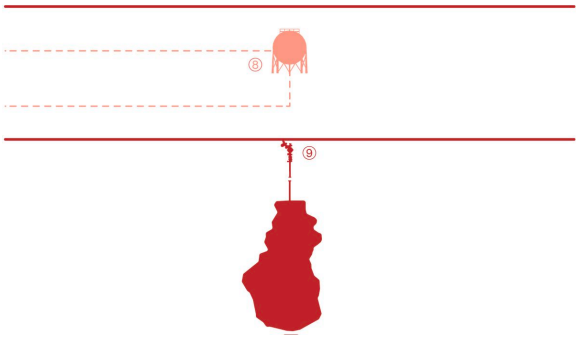

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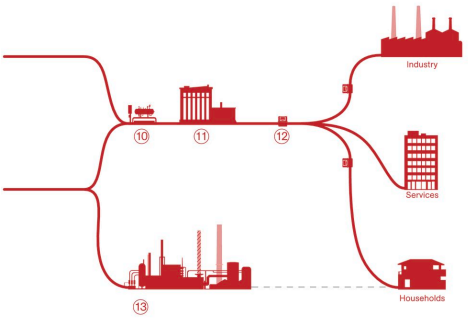

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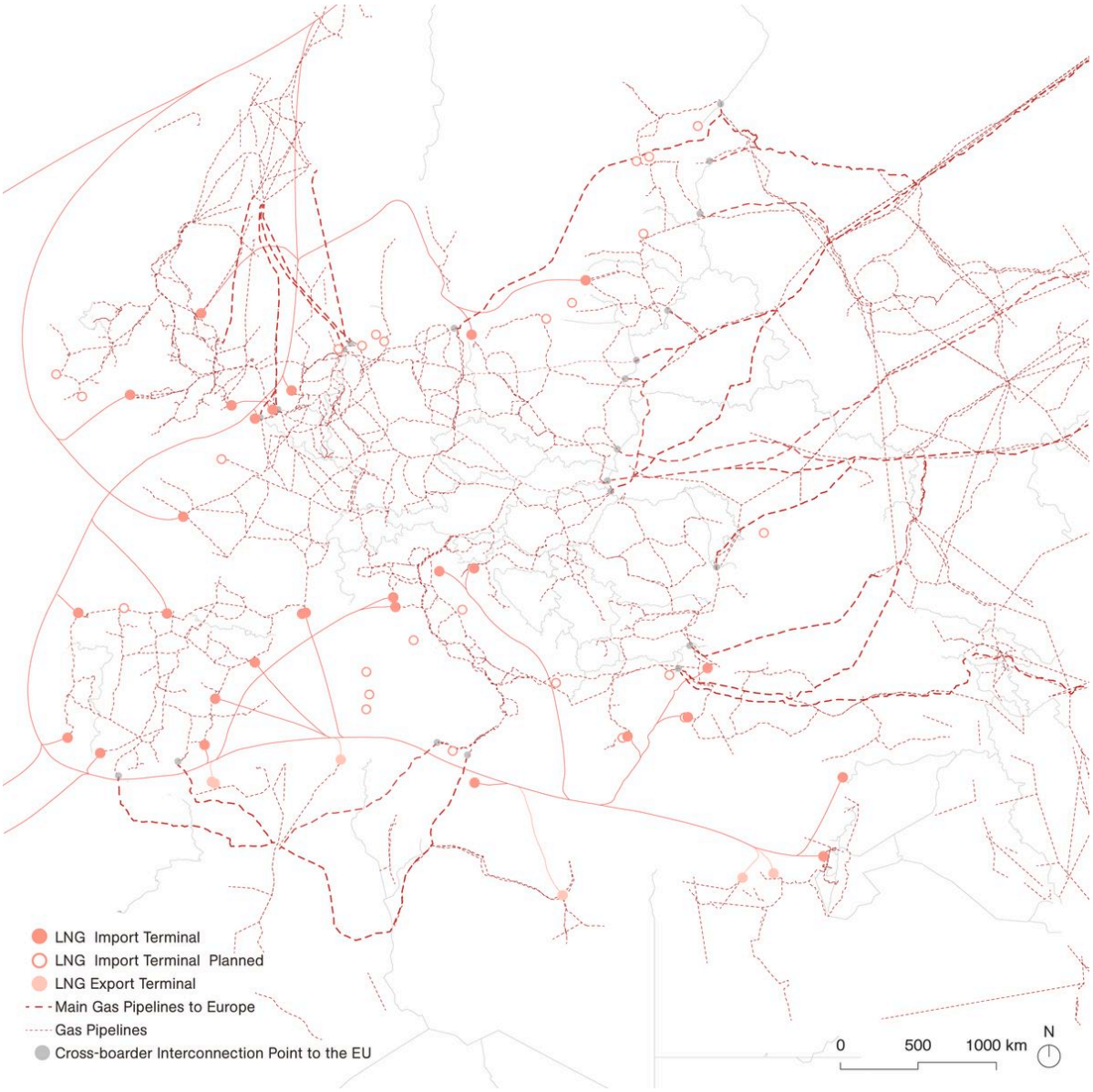
The Geopolitics of Gas: Constructing New Dependencies

CONSTRUCTION OF A NATURAL GAS PIPELINE IN ROHR, SWITZERLAND
Source: Comet Photo AG, 1973 [https://ba.e-pics.ethz.ch/catalog/ETHBIB.Bildarchiv/r/987349/viewmode=infoview/qsr=Gas%20pipeline]

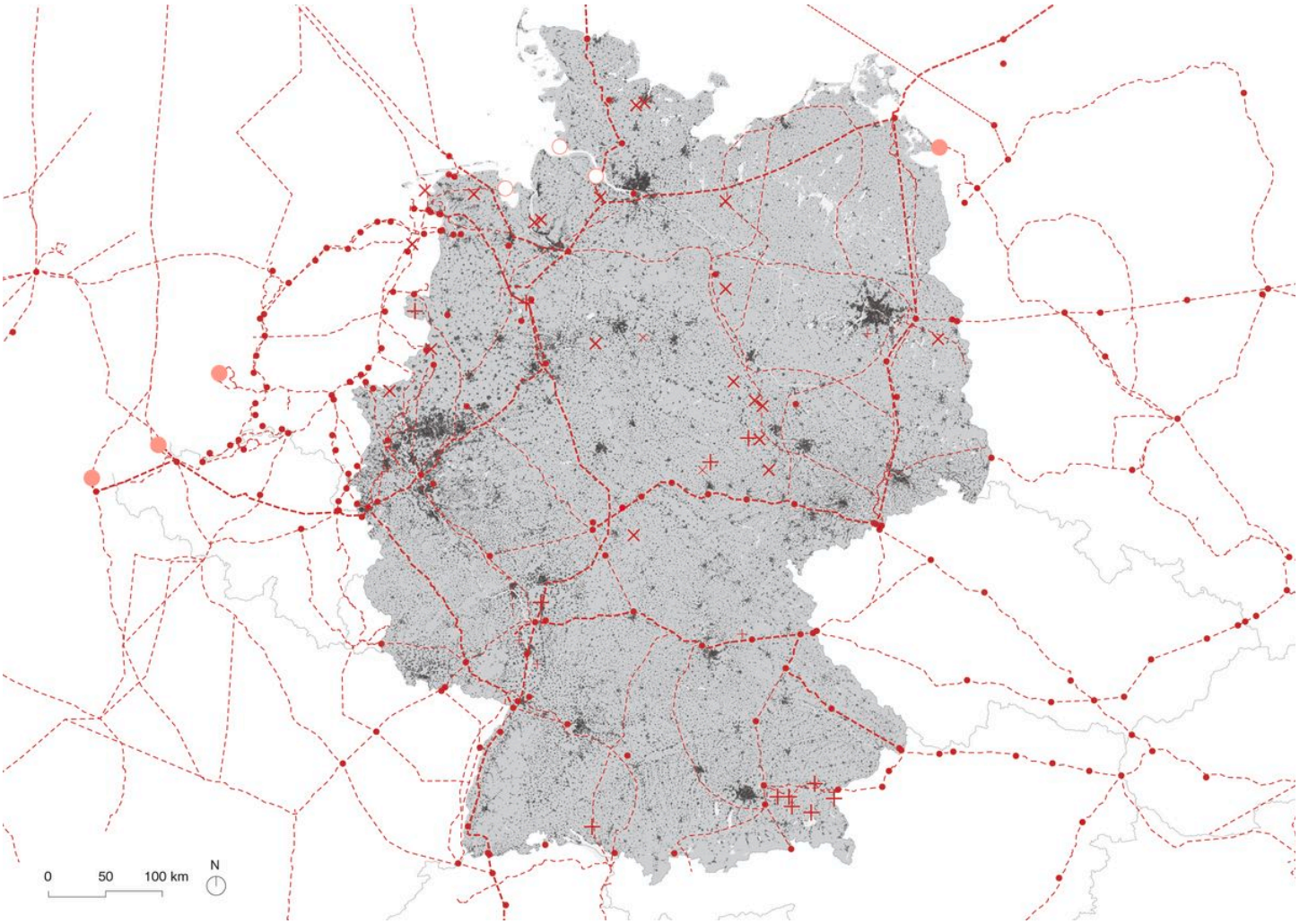
After Russia launched the war on Ukraine, gas quickly became a means of a trade war with huge price increases in response to European sanctions. Since February, it has become clear that the dependence on Russian gas has no future for Europe and specifically Germany, where Russian gas accounts for 66 percent of the country's energy supply in 2020 (Eurostat, 2020). However, not only the current crisis is the problem. Energy and gas supply generally depend on fragile arrangements and treaties between individual states. Focusing on the interest of their own economies, the states act in the words of Friedrich Engels as the "ideal personification of total national capital" (Engels, 1880, p. 222).

Germany concludes treaties and national agreements with despotic leaders and totalitarian economies that oppress their populations—just like Qatar who recently made news with the inhumane working conditions on its building sites. These agreements not only interweave into a network of economic and legal dependency, but are entrenched in the material infrastructure of the gas network that has been built and expanded over decades.



EUROPEAN GAS INFRASTRUCTURE
Source: Global Energy Monitor, 2022 [https://globalenergymonitor.org/projects/global-gas-infrastructure-tracker/]

EUROPEAN GAS IMPORTS BY MAIN SUPPLIERS
Source: Eurostat, 2020 [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Natural_gas_supply_statistics]



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Source: Global Energy Monitor, 2022
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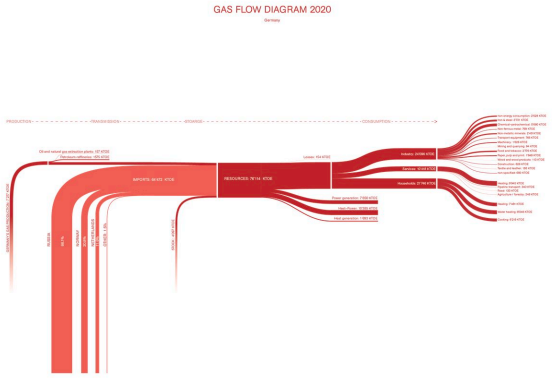
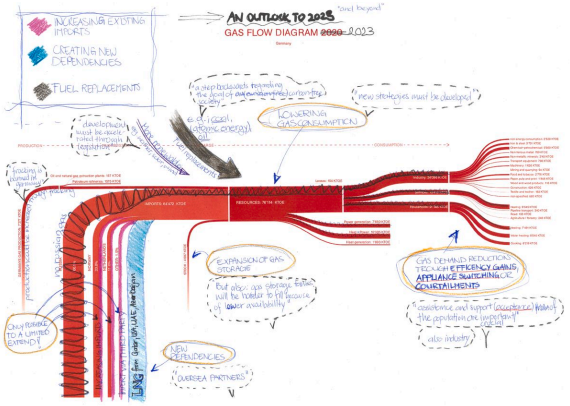


ENERGY BALANCE OF NATURAL GAS
KTOE: The kiloton of oil equivalent (ktoe) is a unit of energy defined as the amount of energy released by burning one tonne of crude oil, approximately 41.868 terajoules (TJ)

Source: Eurostat, 2020 [https://ec.europa.eu/eurostat/cache/sankey/energy/sankey.html?geos=DE&year=2020&unit=KTOE&fuels=G3000_C0350-370&highlight=_&nodeDisagg=0101000000000&flowDisagg=true&translateX=0.44931419241720505&translateY=27.634559672905937&scale=1&language=EN]



Annotations Describing an Imaginable Future for 2023

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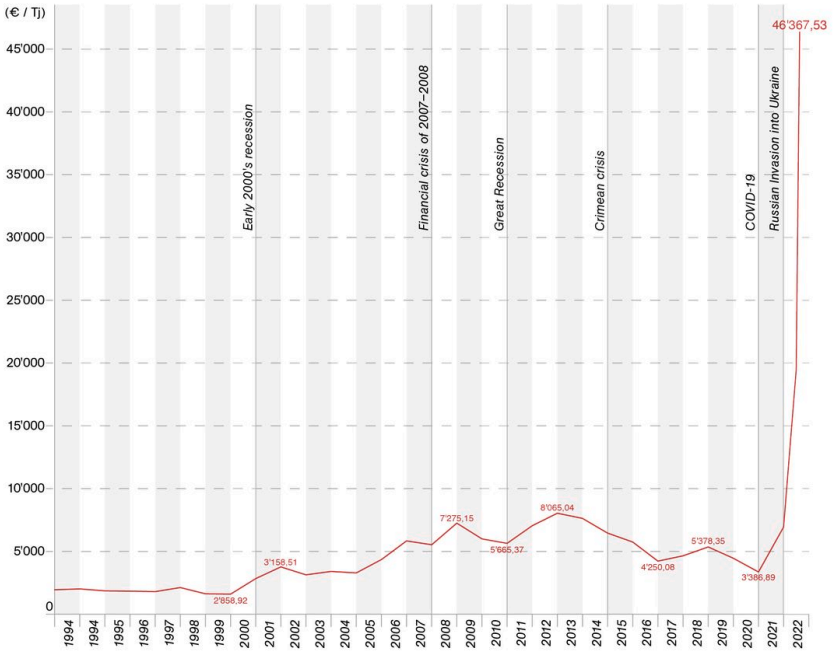

COSTS OF GERMAN NATURAL GAS IMPORTS
Source: Statistisches Bundesamt, 2022
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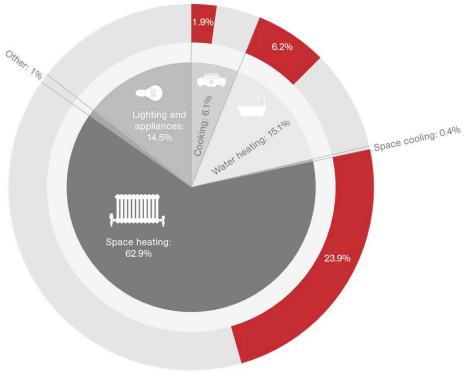

SHARE OF GAS CONSUMPTION IN TOTAL DOMESTIC ENERGY CONSUMPTION
Source: EUROSTAT, 2020
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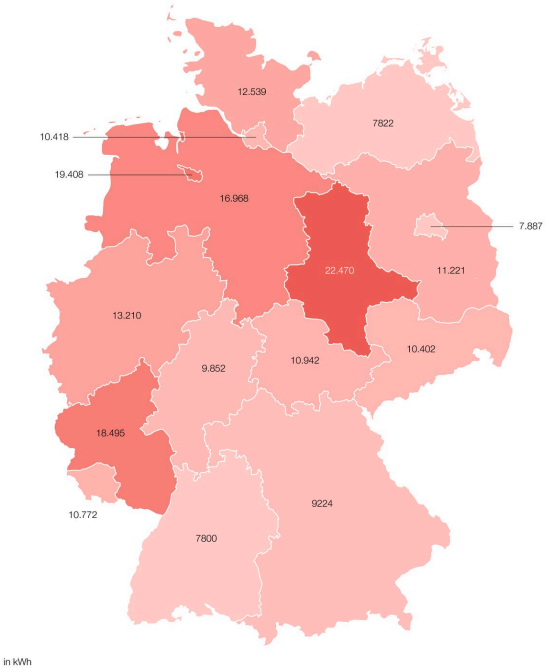

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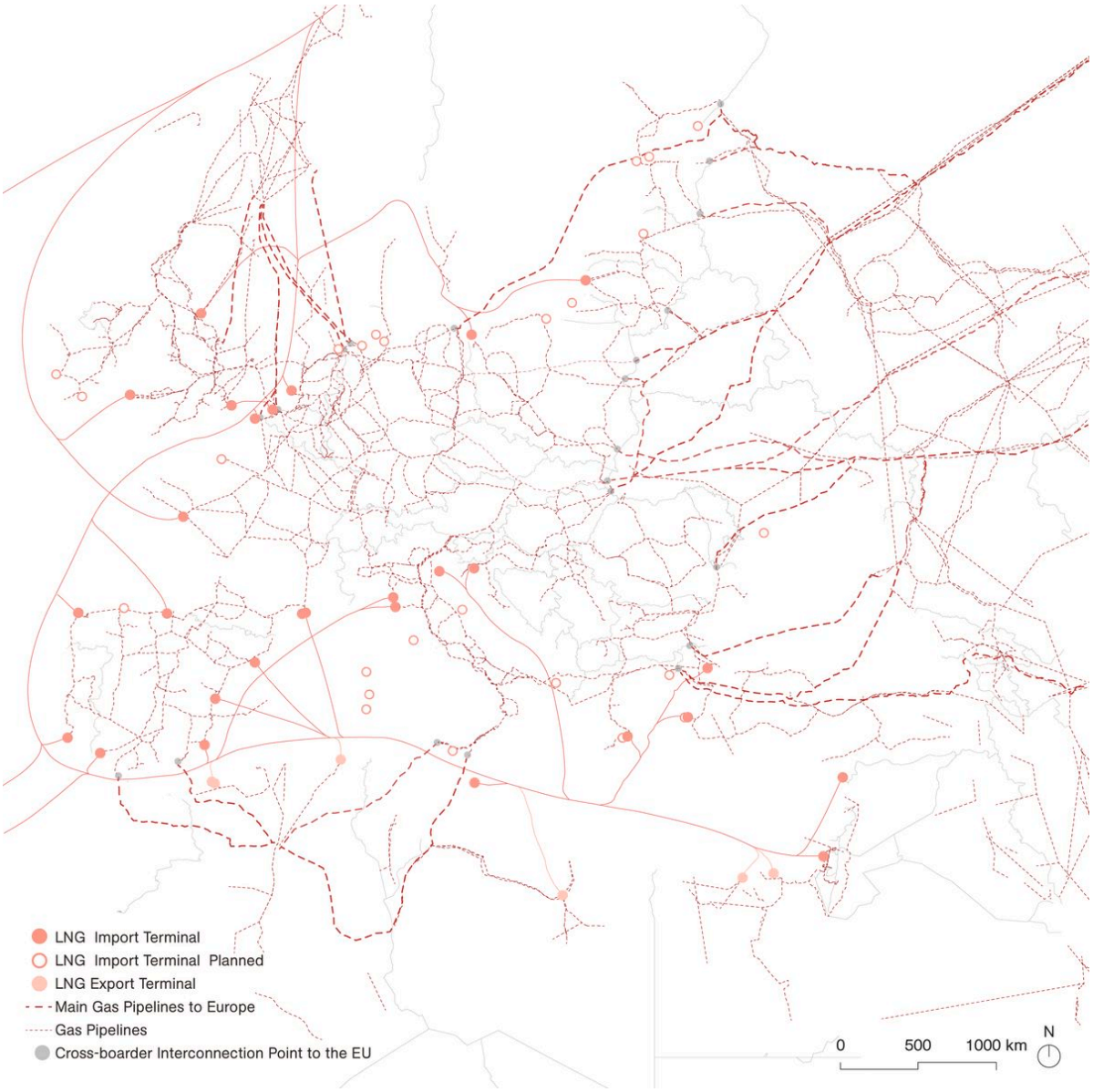

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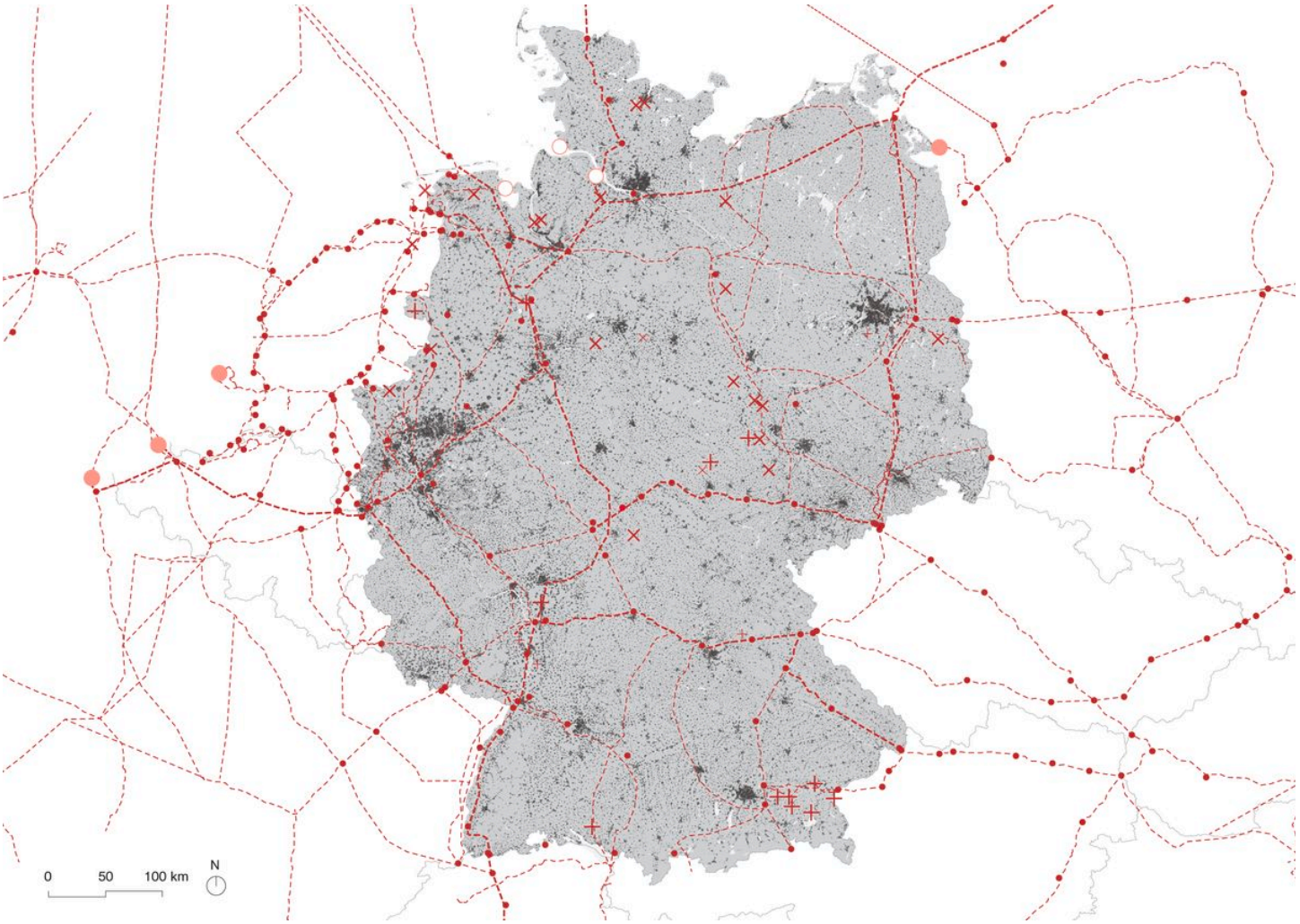

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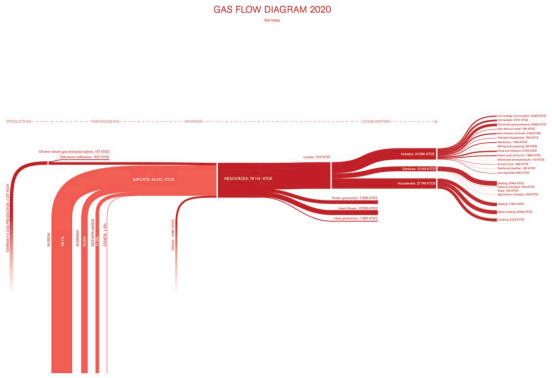

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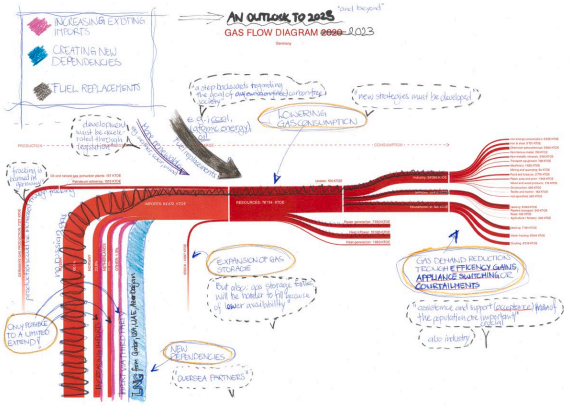

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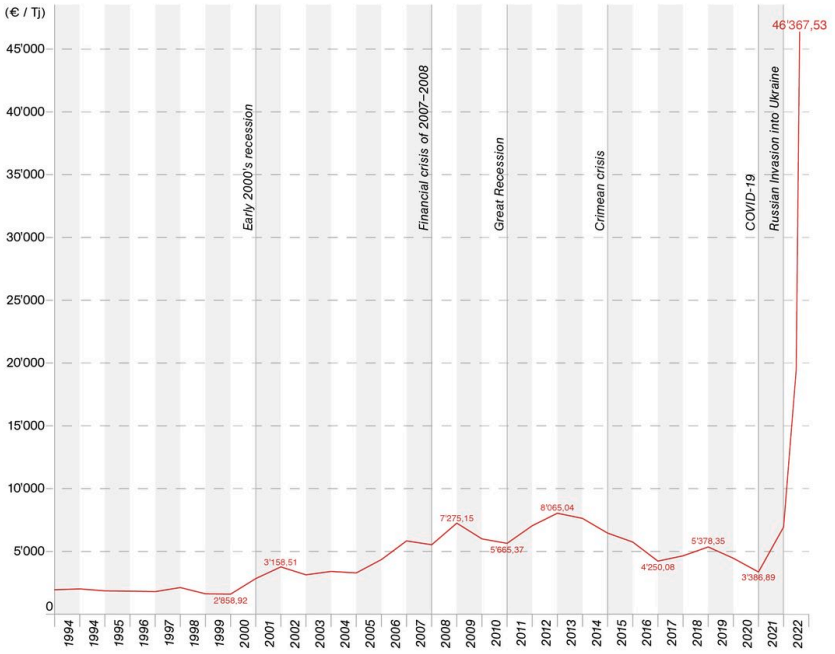

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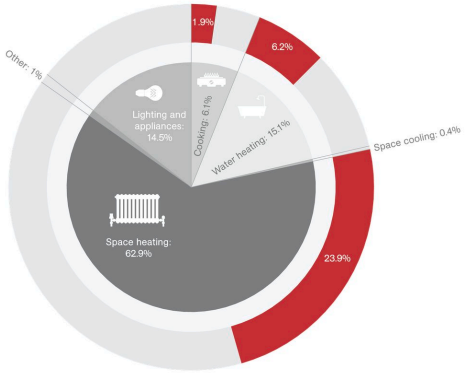

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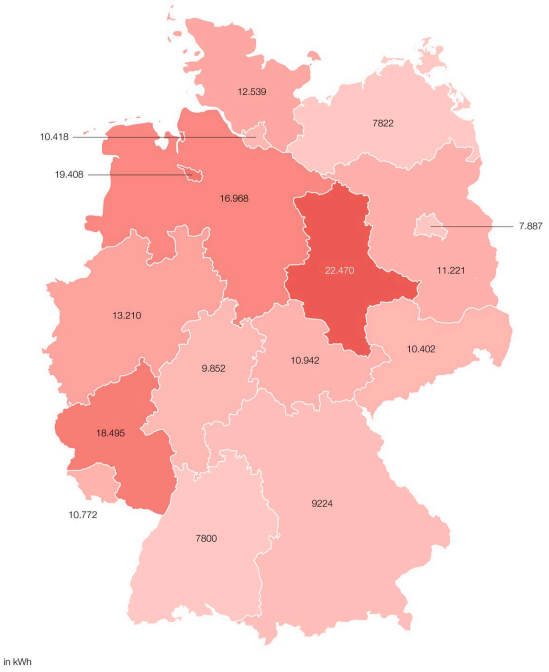

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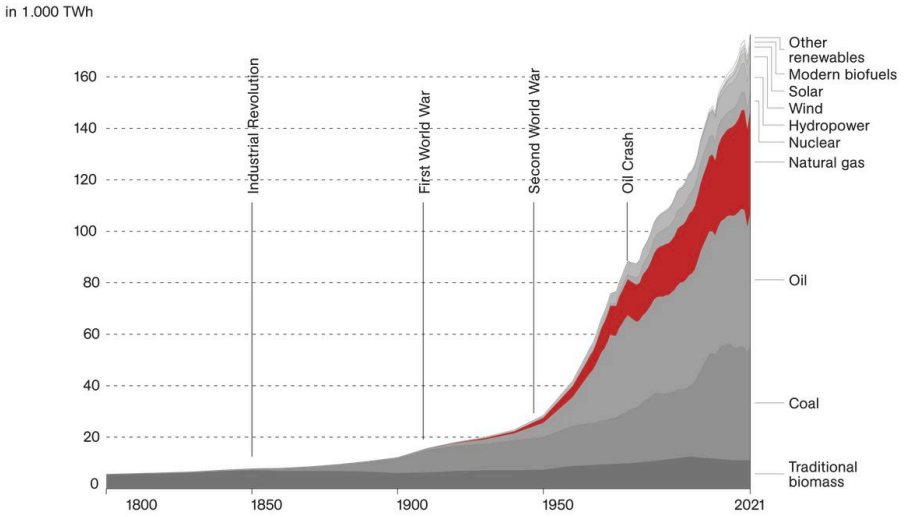
-162°C Or How to Keep Yourself Warm with Cold Gas Lines

CONSTRUCTION OF A NATURAL GAS PIPELINE IN MEIRINGEN; BRIENZER ROTHORN TUNNEL, SWITZERLAND
Source: Hans Witschi, 1973 [https://ba.e-pics.ethz.ch/catalog/ETHBIB.Bildarchiv/r/1118421/viewmode=infoview]

31 % of gas is consumed by private households (BDEW, 2022). Current price spikes make heating an expensive endeavour for gas-fired households, which hits the poorest hardest. So far it has been difficult to secure prices because Germany's gas network is fragmented among private players. The nationalisation of the insolvent gas network operator Uniper and the recently introduced German gas price cap solve this problem for the time being. However, it brings hardship to other European countries with lower budget reserves, such as Slovakia, which cannot keep up with such enormous programs (Tooze/Abadi, 2022). Experts such as the internationally renowned economist Adam Tooze predict an extreme distribution struggle between individual European countries, leaving the economically stronger states on top while the others will fall short.

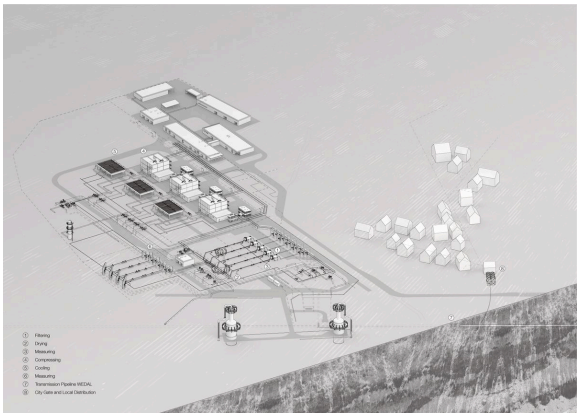
In recent years, the German state has invested in pipelines connecting Dutch LNG terminals with the German network, in order to secure the cheap gas supply in Germany. “Zeelink” is one of these projects, with a newly built compressor station in Würselen, Germany. However, as LNG has to be cooled to a temperature of -162 °C, it is far less CO_2-efficient than conventional gas, and the conversion of power plants will take years.

Both ensuring energy supply for heating in Germany and reducing carbon emissions seems incompatible in the face of the current gas prices. But for a more just and ecological future, new forms of heat and energy supply must be developed and monopolies in the energy industry broken up.

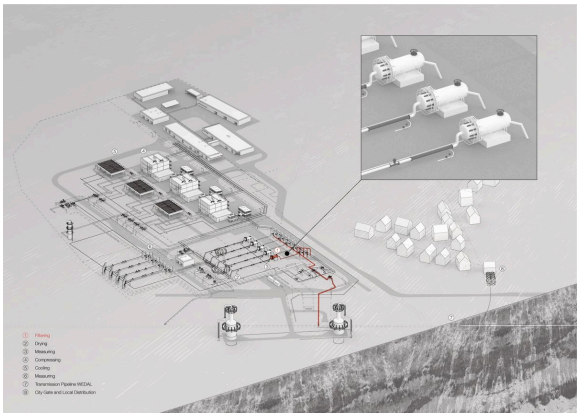


GLOBAL DIRECT PRIMARY ENERGY CONSUMPTION
Source: Vaclav Smil, 2017 [https://vaclavsmil.com/2017/05/08/energy-and-civilization-a-history/], and BP Statistical Review of World Energy, 2022 [https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html]

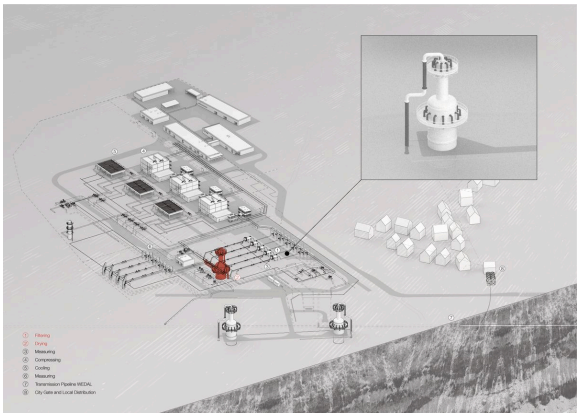
THE CONSTRUCTION OF THE WEDAL PIPELINE
NEAR AACHEN BEING VISIBLE FROM SPACE
Source: Google Earth, 2020
[https://earth.google.com/web/@50.76364619,6.17430957,220.27819666a,13198.32931448d,35y,0h,0t,0r]



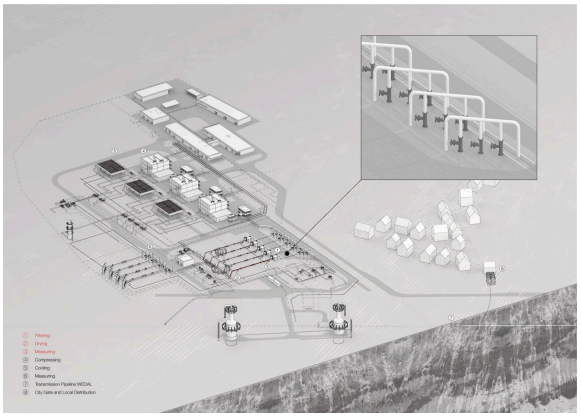
COMPRESSOR STATION ALONGSIDE THE
WEDAL PIPELINE IN WÜRSELEN (GERMANY)
Source: Zeelink, 2017 [https://www.zeelink.de/]



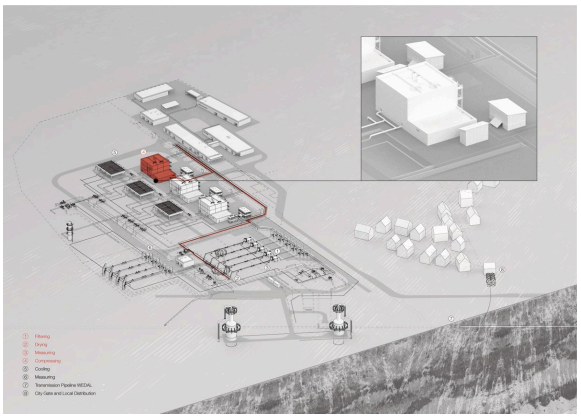
FILTERING



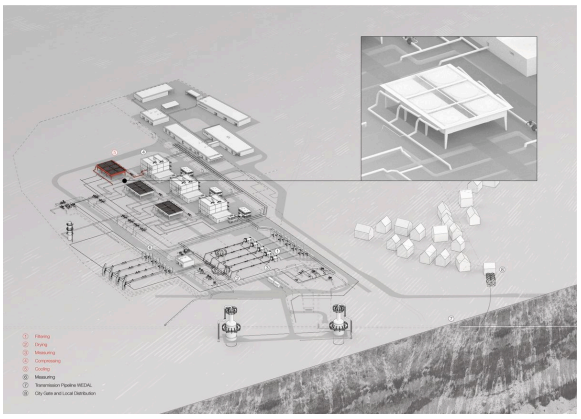
DRYING



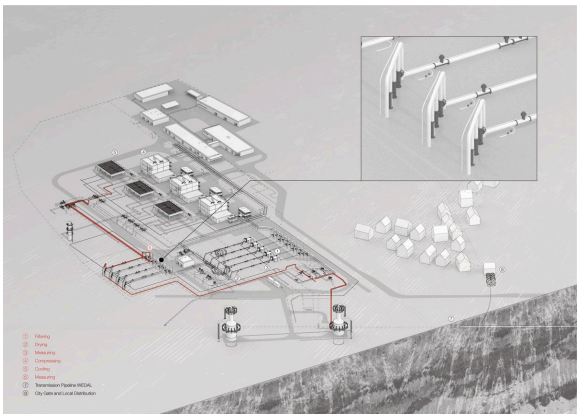
MEASURING



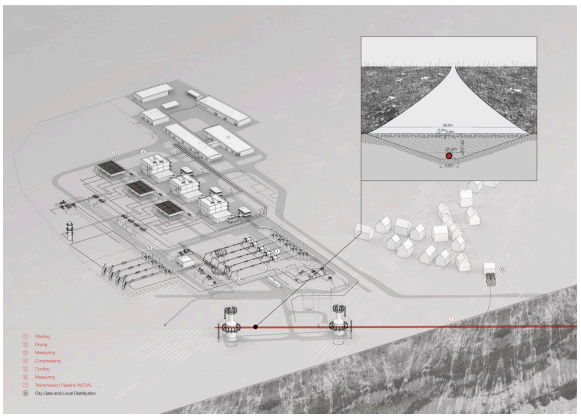
COMPRESSING



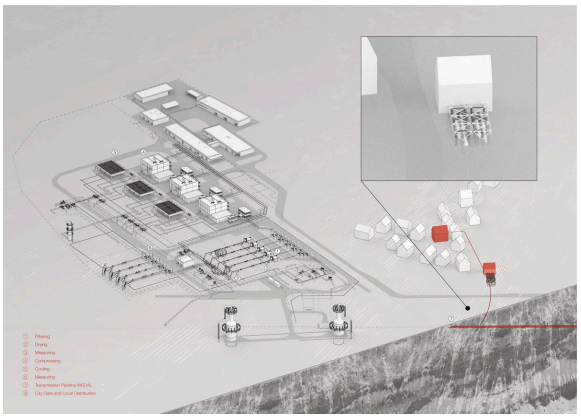
COOLING



MEASURING



WEDAL PIPELINE



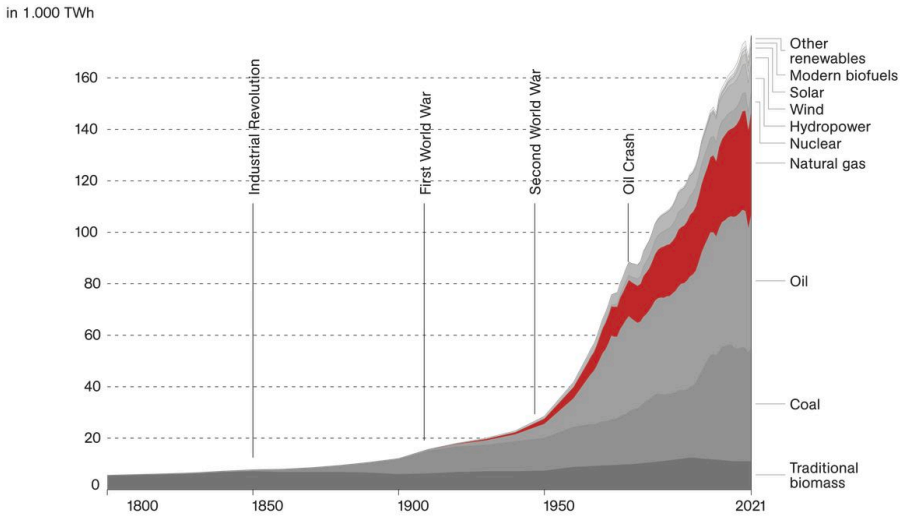
CITY GATE AND LOCAL DISTRIBUTION SYSTEM

CONSTRUCTION OF A NATURAL GAS PIPELINE IN MEIRINGEN; BRIENZER ROTHORN TUNNEL, SWITZERLAND
Source: Hans Witschi, 1973 [https://ba.e-pics.ethz.ch/catalog/ETHBIB.Bildarchiv/r/1118421/viewmode=infoview]

31 % of gas is consumed by private households (BDEW, 2022). Current price spikes make heating an expensive endeavour for gas-fired households, which hits the poorest hardest. So far it has been difficult to secure prices because Germany's gas network is fragmented among private players. The nationalisation of the insolvent gas network operator Uniper and the recently introduced German gas price cap solve this problem for the time being. However, it brings hardship to other European countries with lower budget reserves, such as Slovakia, which cannot keep up with such enormous programs (Tooze/Abadi, 2022). Experts such as the internationally renowned economist Adam Tooze predict an extreme distribution struggle between individual European countries, leaving the economically stronger states on top while the others will fall short.

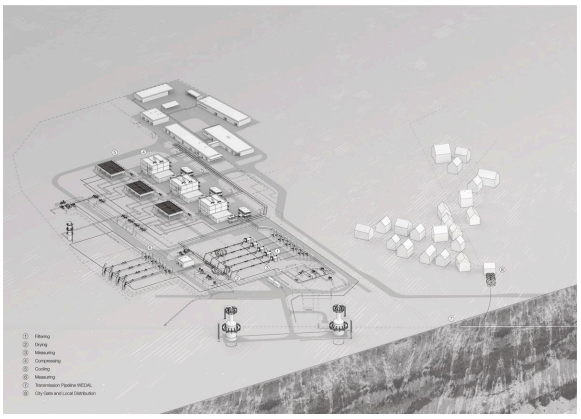
In recent years, the German state has invested in pipelines connecting Dutch LNG terminals with the German network, in order to secure the cheap gas supply in Germany. "Zeelink" is one of these projects, with a newly built compressor station in Würselen, Germany. However, as LNG has to be cooled to a temperature of -162 °C, it is far less CO_2-efficient than conventional gas, and the conversion of power plants will take years.

Both ensuring energy supply for heating in Germany and reducing carbon emissions seems incompatible in the face of the current gas prices. But for a more just and ecological future, new forms of heat and energy supply must be developed and monopolies in the energy industry broken up.

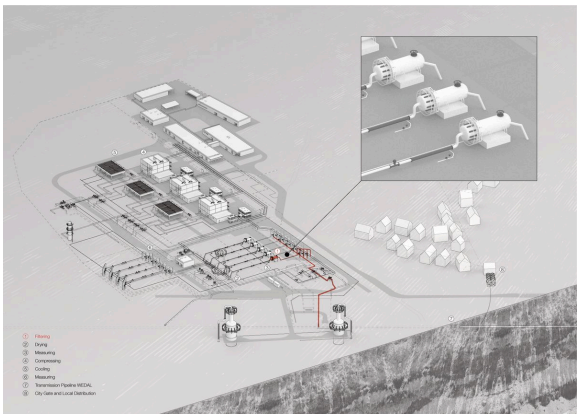


GLOBAL DIRECT PRIMARY ENERGY CONSUMPTION
Source: Vaclav Smil, 2017 [https://vaclavsmil.com/2017/05/08/energy-and-civilization-a-history/], and BP Statistical Review of World Energy, 2022 [https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html]

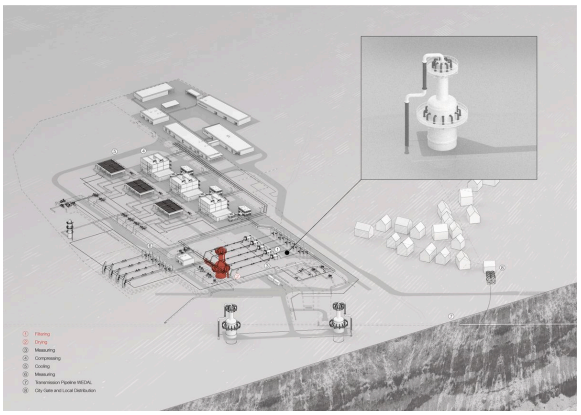
THE CONSTRUCTION OF THE WEDAL PIPELINE
NEAR AACHEN BEING VISIBLE FROM SPACE
Source: Google Earth, 2020
[https://earth.google.com/web/@50.76364619,6.17430957,220.27819666a,13198.32931448d,35y,0h,0t,0r]



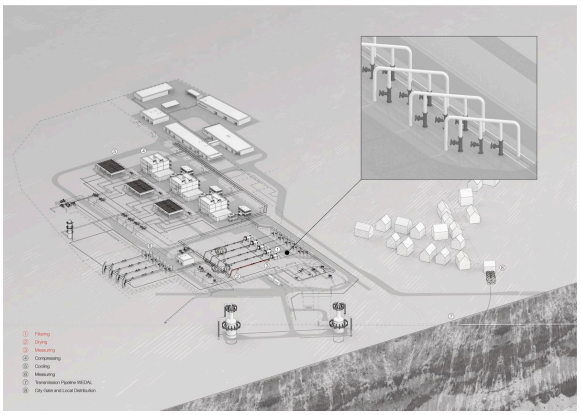
COMPRESSOR STATION ALONGSIDE THE WEDAL PIPELINE IN WÜRSELEN (GERMANY)
Source: Zeelink, 2017 [https://www.zeelink.de/]



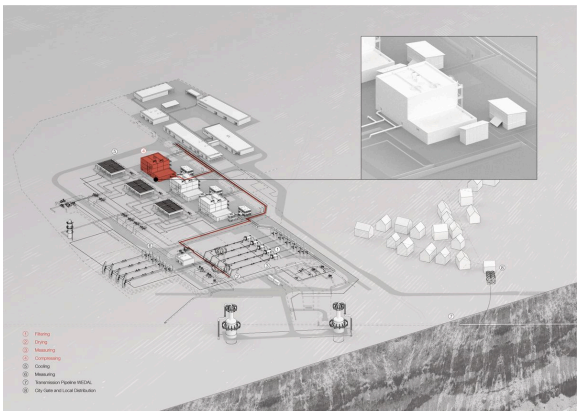
FILTERING



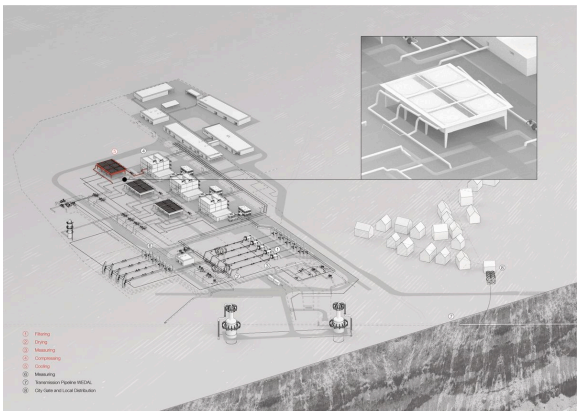
DRYING



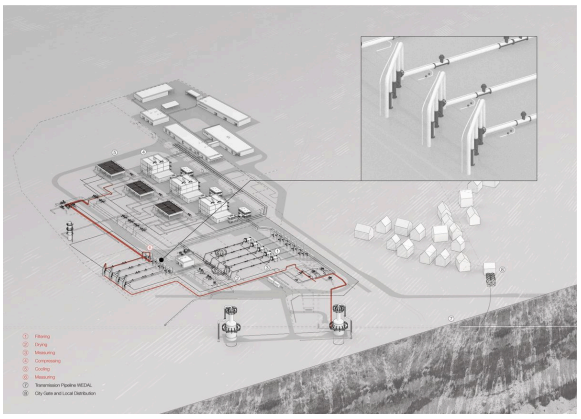
MEASURING



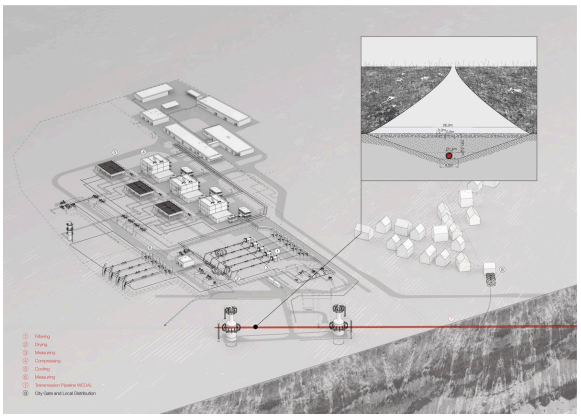
COMPRESSING



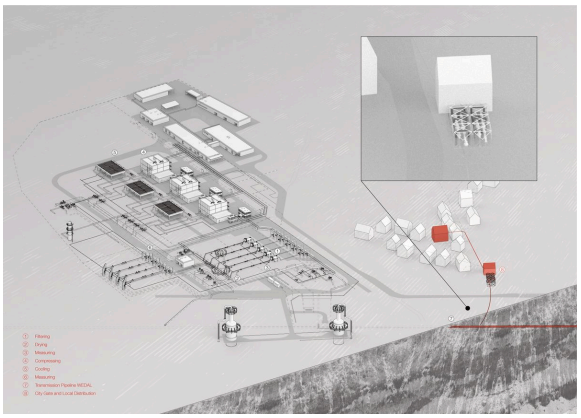
COOLING



MEASURING



WEDAL PIPELINE



CITY GATE AND LOCAL DISTRIBUTION SYSTEM

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