Germany:
Immediate Energy Independance from Russian Fossil Fuel Imports
only by Renewable Energy and Massive Energy / Cost Savings

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A Solutions Study by Zero Emission Think Tank

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[1]**Zero Emission Think Tank**
According to **Bloomberg BNEF** and the **German Bundesnetzagentur (BNA)**, we have green power at **½ the price** since 2017, in Germany. Wind and Solar energy are the cheapest sources of energy, even in Germany, and that`s the „**Silver bullet**" to fight the climate crisis.

Mark Jacobson from Stanford University has recently shown that **100% Renewable Energy Systems** pay off in only ***FIVE (5) years*** (!) on economic grounds only, including sector coupling and green hydrogen for the industry. This is for the US, Germany, and pretty much the same for every country in the world, according to Mark.
Considering additional health and social climate costs, ***the payback for 100% Renewable Energy Systems is only ONE (1) year***.

And if you hear about this for the first time in your life, you realize, we have a problem. And, that`s exactly why climate policy has failed us for decades, you can see it right in front of your eyes: ***Why is nobody aware of it?***

That`s why Ingo Stuckmann and Eicke Weber have formed Zero Emission Think Tank to get the economic truth out into the public, into universities, into schools, into the climate movement and politics, into businesses, into the start-up scene; let`s TALK ABOUT climate solutions – ***it`s even cheaper to act on climate!***

Zero Emission Think Tank`s mission is to provide educational materials like simple checklists for politicians, and for all of us to act on, given that this is the last chance to prevent catastrophic climate change: We are on a highway to the heat age with unimaginable sufferings in a largely uninhabitable world, and, ***we are even paying for it?!***

Zero Emission Think Tank greatly appreciates the **support** and the **monumental work** on simple **solutions** from **Amory Lovins**, **Mark Jacobson**, **Tony Seba**, **Dan Kammen**, **Christian Breyer**, **Hans-Josef Fell** and **Hermann Scheer** [+], and others.

Symbolizing the KEY POINT
And, we want to promote the KEY POINT: it`s even cheaper to act on climate. We need a symbol for it that everybody understands. And, we found it: The **Climate-Medal** (@climatemedal4f on instagram), with the KEY QUESTION, i.e. what`s on the other side of the medal, *how much does it cost, to solve the climate crisis?*
It`s written on the other side of the medal:
Wind & Solar at ½ the price – that is so nice!
No excuses left. www.ZeroEmissionThinkTank.org

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Thank you!
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Special thanks to **Hans-Josef Fell** www.energywatchgroup.org for many well structured specific policy proposals, and, for introducing the feed-in tariff for renewable energy (EEG 2000) in Germany, that was copied in over 70 countries in the world, including China, driving costs exponentially down for renewable energy. His and Herman Scheer`s work for the feed-in tariff in Germany have basically laid the groundwork that we have cheap renewables at our finger tips today, the key solution (the "**silver bullet**") to act on climate.
The authors also wish to thank **Carina Henneke, Christa Stiller-Ludwig, Karen Modersohn, Sabine Thie-Olliges, Alexandra Morgan, Sofia Mayte Rodriguez, Ingrid Knaup, Christian Meyer, Enrico Donati, Klaus Vomoelberg, Fabian Stuckmann, Lars Schnatmann, Thomas Ladwig, Stefan Grote, Paul van Son, Cornelius Matthes, Thorsten Barth, Klaus Müller, Jürgen Eiselt und Stefan Gsänger** for great discussions and developing pragmatic policy solutions.
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Foreword Fossil Natural Gas Replacement / Dr. Ingo Stuckmann

Independent of whether **Russia** cuts off **fossil natural gas** deliveries to Germany, as they just did for the Jamal pipeline to Poland and Bulgaria, or whether the **EU** decides to ban it, the questions for **Germany** are always the same:

How do we get through the **next winter** without Russian Gas?
How do we protect our **core industry** from bankruptcies and **mass unemployment**?

And this means **Energiewende**, the energy transition.
And it also means paying a high price now for our political failures of the past!

It is the **Pioneers** that have shown us for quite some time, how we can live without fossil fuel energy, completely **free** of **energy costs**.

A good example is the **first solar net zero energy home** of the world, built by **Amory Lovins** in the Rocky Mountains in **1983**. It inspired the German and North European **Passive home movement** by the end of the 80ies.
Even though this technology is known for decades now, it has not been politically possible to introduce a net zero energy standard in Germany for newly to be built homes, nor for remodelling old homes, because we were always thinking -the author included- that such homes are just too expensive to build, we cannot afford them. Let`s keep heating.

However, a recent visit with **Amory Lovins** tells a very different story (Stuckmann, Historisches Interview mit Amory Lovins, 2022): Yes, insulating your home costs more money, says Amory, but just keep insulating more, until you reach the top of the bell curve, and, suddenly, you do not need a furnace anymore, no heat tubes anymore, no installation costs, down the bell curve goes: Amory`s net zero energy home was even cheaper to be built than a comparable home with furnace and full blown heating system. Even cheaper!
And, let alone $100,000 in avoided heating costs for 38 years - Amory has never seen a heating bill.
And it works, as can be seen by Amory`s recent 38th **banana** harvest – with **- 20** degrees outside and 39 days without sun in the winter!

This example shows dramatically why our **climate policy** has **failed** us for decades.
(Stuckmann, Die Lösung der Klimakrise - zum Greifen nah, 2022).
It is not the more expensive **heating bills** today that we should be concerned about, it is **having heating bills at all** that is the real **social injustice** – completely unnecessary for all of us - for **38 years** now! What a story.

And so we **keep paying** our heating bills every months, still believing it would be too expensive to build a net zero energy home. The **cost trap** snaps in our heads, again and again, and we pay for it every month, instead of **super-insulating** our homes which is even cheaper, without furnace, and using **solar energy for free**. *And nobody heard about it before?*
Not even myself, until I visited with Amory.

The exact **opposite is true**: Finally, the **SPIEGEL** is the first mass media that published this in Germany for the first time the day of the last German federal elections happened, the **Bundestagswahl** (26.09.) and thereafter: „it is stupid to think climate policy is expensive“ and „the opposite is correct”; it will even be „**cheaper**“, because of extremely cheap renewable energy, and we are really talking about „**Trillions** (of Dollars) in **Savings**“ (Stöcker, DER SPIEGEL, 2021) (Fricke, 2021). And that`s why we have to focus on solutions now (Stöcker, 2022).

And this is also based on recent **Energy System Studies** that show that 100% renewable energy systems are actually **cheaper** than keep going as we are. And this is including, but not limited to sector coupling and hydrogen for the industry Industrie (Jacobson, 2022) (Jacobson, 2022) (Seba, 2022) (BEE, 2021) (Whooley, David, 2020) (Energy Watch Group, 2019).

It is especially **Mark Jacobson** from **Stanford University** that started such energy system studies already back in **2009** (Jacobson, 2009), which became the basis for the **Green New Deal** that Alexandria Octavio-Cortez and Ed Markey presented in 2019.
At the time of the **Paris World Climate Summit,** Mark had run his model for essentially **all Countries** of the world, showing that renewable energy systems are always **cheaper** than the ones we have today in a fossil fuel based world (www.thesolutionsproject.org). Mark updated his studies recently with **dramatic results** (see references mentioned above):
When I met Mark recently (Stuckmann, Historisches Interview mit Mark Jacobson, 2022), he tells me that the economic impact for the US or Germany, and, pretty much for any other Country in the world is using only **half** the **Energy** in the future, because electrification is way more efficient than fossil fuel combustion processes today. And, **Renewable Energy** is available today at **half the price**, which means we will **only have ¼ of the energy costs** in a 100% Renewable Energy future.
But, we need large investments into renewable energy, EVs, home insulations, sector coupling and green hydrogen; so when does it **pay off**?
And Mark tells me the unbelievable – it pays off in only **five (5) years**!
Let alone any climate social costs, avoided respiratory problems and billions in doctors`bills, loosing Miami to the rising Seas by 2065 – if you include all these climate social costs, the future 100% Renewable Energy System pays off in – **one (1) year!!!**
That`s the economic truth to act on climate, for the US, for Germany, and for almost every other country in the world.

But if we think of the energy transition, the same picture comes to mind again, contrary to Mark`s studies: We still believe that the **energy transition** is **too expensive** and that we cannot afford it. And the **cost trap** snaps again in our head, let`s don`t move too fast.
Even for myself, I was not aware of Mark`s dramatic numbers, until I met with him.
And again, the **opposite** is **true**; We are paying for our ignorance, every day – completely unnecessarily – for a much more expensive fossil fuel system, milking all of us every day.
And nobody heard about it before? How can this happen?!

Indeed it is a **design error** in our western democracies political systems which I have analyzed in detail, separately (Stuckmann, Historisches Interview mit Mark Jacobson, 2022).

„Und so ist das **Kind** in den **Brunnen** gefallen." (German saying, that`s how the child fell into the cave) And we do not have time anymore, to super-insulate our homes, to all of us get EVs and to electrify our economy. Our decades of failing climate policies does not only cost us money now, each of us at the pump (if you don`t have an EV yet), our heating bills; we are also paying a high price *with the death toll of human lives in Ukraine, every day!*

That`s why we have tried to find **abbreviations** for this study, in order to save our Country, and prevent industry bankruptcies, mass unemployment and social unrest in the event of a Russian energy ban. We have tried to focus on **economic** measures that are **technically** doable, **easy** to implement, **scalable**, and organizable with existing **municipal structures.** *And we found them.*

We identified **3 measures** to almost completely replace Russian natural gas imports, and, in addition, we can reduce Germany`s carbon footprint by a third, *saving massive amounts on heating bills. Forever.*

While reading these lines about „heating bills", I have to think of **Amory Lovins** again, who has never had a **heating bill**.

Amory recently received the **Bundesverdienstkreuz**, for highest honors, from the President of Germany, Frank Walter Steinmeier, even though obviously the then German government had not even understood his work.
And, along these lines, perhaps **Mark Jacobson** should be the next to receive the Bundesverdienstkreuz, as his work has completely been ignored by German politics as well!

But, in order to symbolize this „**key point**", how to solve the climate crisis, we have started **climate-medal** (@climatemedal4f on Instagram) because it is all about the **other side of the medal**, "how much does it cost?" And the answer to this question is written on the "other side" of the climate-medal itself: „**Wind & Solar at half the price – that is so nice!**" And if we understand this key point, we all deserve to win a climate-medal: And that`s the **silver bullet** to fight the climate crisis.
It`s even cheaper to switch to 100% cheap renewable energy. No excuses left.

In addition, we should all be aware of tipping climate **tipping points** beyond 1.5 degrees Celsius. The thawing of the **Permafrost** alone will add an additional +**1,6 degrees Celsius** heating the atmosphere further. In addition!

So, what does it mean for us?
Very simple, we **can`t stop the world** at **2 degrees** Celsius, because the tipping points are tipping: It`s **either 1.5** degrees – or that`s it! On our highway to a catastrophic **heat age**!
And that`s the reality for our children today, "1.5 degrees or highway to hell."

And that`s why we urgently need to focus on **solutions** now, to solve the **climate crisis** once and for all. And, by God, we have these solutions at our **finger tips** – as Amory and Mark, Tony Seba and others have shown, and, these **solutions are even cheaper!**
Let`s bring them **on stage**. Let`s TALK ABOUT it. Let`s TALK ABOUT the solutions where ever we can; at College, at School, with friends and let`s demand them from politicians, it`s very simple: ***Are you with us or not?***
These easy and cheap **solutions** are the **last chance** for Millennials and Gen X to turn onto the 1,5 degrees pathway for their lifetime. Let`s **demand** these solutions from politicians with simple **checklists**, so it is **easy to check on them,** and, it`s cheaper.
Let`s bring these **solutions on stage**, and that`s precisely why Prof. Eicke Weber and I have formed **Zero Emission Think Tank** / **NGO**, with friendly support from Amory Lovins, Tony Seba, Mark Jacobson, Dan Kammen, Hans-Josef Fell, Christian Breyer and many others.

It is still possible to **get on the left lane** for the energy transition in Germany (Stuckmann, Überholspur für die Energiewende, 2021), as this study shows.
Wind & Solar at half the price – that is so nice. And saves human lives.

Executive Summary

Recent studies have shown that it is possible to substitute **Russian fossil fuel imports** to Germany with LNG and other fossil fuel imports from **diversified sources** (Fischer & Küper, 2022) (Leopoldina, 2022). However, fossil fuels have to be procured on the world markets at **extra costs**, with increasing **carbon emissions** („*loose-loose*"-approach).

To the contrary, our **Solutions-study** takes a „*win-win*"-approach, by substituting Russian fossil fuel imports only with **cheap renewable energy**, and energy efficiency resulting in **massive cost savings**. Our solutions approach is much **cheaper** („*win*"), resulting in annual savings of **10 BN**[1] Euros for heating costs alone.

All measures are designed for **private households** and private transportation only. There are no restrictions on the industry.
In addition, we have developed 3 measures to completely replace Russian fossil natural gas imports in the short term.

(i) Connect existing **biogas plants** to the **pipeline** system
(ii) Exchange of gas furnaces by 330,000 **heat pumps** für 3.3 Million homes (10:1), & **type-open permits** for already permitted wind turbine projects to power them
(iii) **Indoor Insulation** of 4.8 Million homes with a simple home hardware Do-it-yourself ("DIY") approach

As a by-product, the measures slash Germany`s **carbon emissions** by a **third** within 12 months (the second "win"), allowing Germany for the **first time in recent history** to turn onto the **path to 1.5-degrees.**

The **German government** has been scrambling for weeks now, to diversify fossil fuel sources and to simply secure enough fossil fuel supplies for the German industry and for heating homes in the upcoming winter. This approach has greatly strengthened Germany`s **energy reliability** to date. However, the authors of this study, suggest that the German government, now that energy reliability has been secured, switch and turn to a **solutions strategy** with cheap renewables and **massive** energy **cost savings** for all times.

Summary

Goal: Short term replacement of Russian fossil fuel imports to Germany

The study shows that it is possible to replace all Russian fossil fuel imports by October with fast tracking cheap **Renewable Energy** installations, especially wind power that is crucially needed in the winter to power new heat pumps, in addition to much greater **energy efficiency** and **energy savings** for transport (avoid „every 5th drive", „bikes and E-bikes for short, inner-city distances", „1 Million EVs"), for heating homes (home heating „2 degrees less", „indoor insulation of every 4th home", as well as more wind energy for new heat pumps ("cut off every 6th gas faucet")

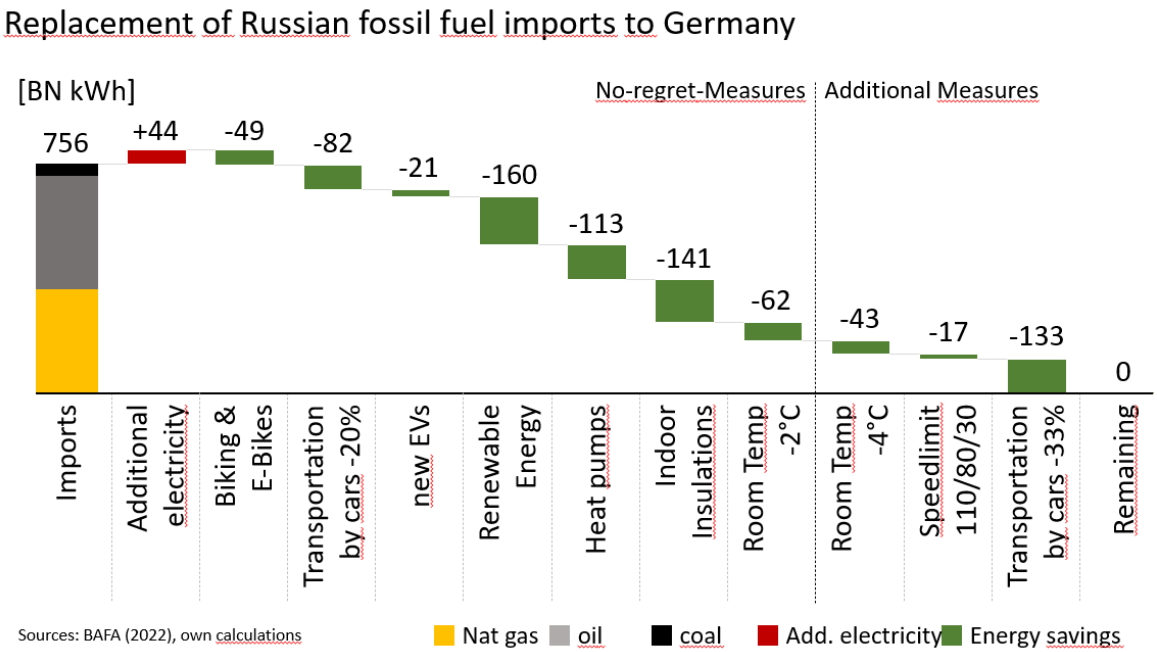
It`s all „**no-regret**"-measures, i.e. measures that pay off purely on economic grounds.
It is also possible to even replace Russian fossil fuel imports that have already been diversified by other fossil fuel sources (Bundesministerium für Wirtschaft und Klimaschutz, 2022).
However, it takes several **additional measures** that are **more severe** to especially replace Russian **oil** imports. Amongst them is a substantial **reduction of private transport** (not just replacing "every 5th ride", but also "every 4th ride"), a **temporary speed limit** to 110km/h on

[1] Massive cost reductions for heating homes, calculations: Indoor insulation saves: 100 BN kWh x 10 cents/kWh (saved fossil gas heating costs) = 10 BN Euro. By saving 100 BN kWh fossil natural gas, respective cost savings amount to 10 BN Euros.

highways, 80km/h out off own, and 30km/h in town, as well as **temporarily** turning down **home heating by 4 degrees Celsius**, not just by 2 degrees.

The last 2 measures are temporary, and can be lifted after a year when massive energy savings and renewable energy installations have taken effect.

All measures together can replace all Russian fossil fuel imports by October.
We also investigated the **immediate replacement** of all Russian fossil fuels which is possible. However, it requires a temporary access to the **national oil- and gas reserves** for the Summer quarter. The reserves would then be replenished in the Autumn and Winter quarters when massive energy savings allow for the national oil and gas reserves to be filled up again through the continued supply of non-russian fossil fuel imports.



Grafic A: *Replacement of Russian fossil fuel imports by Renewable Energy and Energy Savings.*

Short term stop of Russian gas deliveries

Germany imports about **350 BN** Kilowatthours (kWh) of Russian fossil natural gas (40% of all **gas imports** for Germany). The study focusses on measures that are scalable in the short run, and that have the potential to massively save on heat and heating costs, and, without relying too much on supply chain issues and craftsmen and women given the tight labor market in Germany.

Because all measures save massive amounts of energy and energy costs for private homes and appartments, the remaining **non-Russian gas imports** are available to the **Industry** securing Germany`s industrial core.

The study specifically finds **3 measures** that are each capable of replacing about $^{1}/_{3}$ of der Russian fossil natural gas imports:

i) Connect the existing 10,000 **biogas plants** to the **pipelines** to fill up the national gas reserves for the winter.
ii) Allow for „brand-open“ permits for about 2,000 existing wind turbine permits, to produce **50% more wind power** in the Winter for **330,000** new **heat pumps** which can supply heating power to **3.3 Mio. homes** as long as the German Government allows for

distributed **neighbor-energy centers**, to get rid of an equal amount of homes from gas supplies.

iii) **Indoor-Insulation** of about **4.8 Mio. Homes** through a simple do-it-yourself home hardware video. This requires a mobilization of the civil society.

Challenges and implementation

The authors expect huge problems when scaling up the respective **measures**. Therefore, an outreach strategy was developed:

Indoor insulations

The study recommends an „**Energy-Independance-Week“** for all students nationwide where they would learn how to insulate their own **classrooms** under the supervision of home hardware employees or other qualified craftswo:men. The results can be shown to parents in a subsequent **Action Week**, in which students can teach their parents how to insulate their own homes, helping them to achieve massive heating cost savings that are furthermore affecting underpriviliged communities to a greater extent, contributing to **climate justice**. During the summer break, schools can be used as “**Energy Independence Centers**”, whereby interested people can learn how students insulated their own classrooms. They furthermore should be able to fill out a simple **1 page application** “**heating at half the price**” at this **one-stop-shop** to let their homes be **insulated – at no extra costs**. It is critically important that such applications be online, so that climate managers can also use them within their municipal structures to locate and proactively visit with as many people as possible in their district.

For financing this, the study suggests a one time 5,000,- Euro **“Indoor-Insulation-Premium”** to cover the costs for indoor insulations (see „**All paid for**“-calculations in Annex 3d).

The installation of **Indoor-insulations** can be organized by volunteers through „**Energy-Independence-Weeks**“ similarly to the known voluntary “Social Year”. Students and other volunteers can help others that have applied for insulating their homes. They would get a lumpsum success fee paid for each insulated home – financed through a portion of the „Energy Independance Premium“ mentioned above.
Large **societal groups** like the 1 million people at the **climate movement**, parents for **10 million students**, and, especially **the retired** can benefit from such programs to earn supplemental income.

With this mobilization to insulate about 4.8 Million homes, Germany can replace 1/3 of its Russian fossil natural gas imports.

The key point however is a federal/states **emergency order** to make these indoor insulations for schools mandatory, and, municipalities need to have **mandatory reach out** programs to reach their **quota.**

In the event these measures would be reduced from mandatory to **voluntary**, then, the massive heating cost savings in schools will not be realized, illustrating again the complete failure of municipal climate policies of the past 30 years, even though passive homes with their massive heating cost savings pay off economically for decades already, as shown by the City of Frankfurt with passive home school standards already 20 years ago (Bretzke, 2005) (Feist, 2007). It pays off especially in recent years, when the federal government has come up with a municipal **100% loan program** with an interest rate around zero („*costs nothing & pays off by savings*“).
That`s why an emergency order is suggested with a mandatory „Energy Independance Week“ for all schools, as well as mandatory reach out programs at the municipal level.

Cut Gas Supplies

An additional element is another 5,000,- Euro **"Energy-Independance-Premium**" with the goal to cut **3.3 Million private homes off** from fossil natural gas supplies, once they have a heat pump installed which again saves about **1/3 of Russian** fossil natural gas.

It is not possible though for Germany to install **3.3 Million heat pumps** in a given year. However, if this number were to be reduced by a factor of **1:10**, Germany would only need **330,000** heat pumps which is only about twice as many as were installed last year, and that looks doable now.
Interestingly enough, existing **14.9 kW heat pumps** often run on less than 20% of their capacity in winter, and, could therefore be shared with 5 homes or 10 apartments when running around the clock.
Therefore, the study suggests "**Energy-Sharing**" enabling legislation for heat-sharing, and, therefore, energy sharing communities. The simplest form of community energy sharing is an apartment building.
Furthermore, such community energy sharing projects should not require a building permit, but just a simple registration.
Especially, the **Energiewirtschaftsgesetz** (EnWG) needs to be **changed** with inserting the sentence that „using energy behind the meter shall **not** be considered **energy delivery**" (Meyer Consulting, 2022).
With this change, solar power and heat pumps could be shared amongst community members by simply sharing **running costs**.
So far community energy sharing is overburdened by bureaucracy and practically impossible in Germany (Meyer Consulting, 2022).

Holiday sales event

It is recommended to pay any **premiums** in a „**sales event**" manner only, i.e. in limited tranches with a time stamp on them on a "first comes, first serves" basis. The expected rush is a desired by-product in order to replace Russian fossil natural gas as soon as possible.

PR

All activities should be explained to the people in a **federal PR-campaign**, supported by local, **municipal PR-campaign** to support the mandatory reach out campaign to private homes. All to be organized within existing municipal structures like schools, community colleges, municipal utilities, consumer organizations and climate managers.

Mobilizing civil society

The PR budget should be supplemented by a **decentral PR-Budget**, i.e. a budget for civic organizations interested in spreading the word to mobilize their own base. Such civic organizations could be the climate movement, environmental organizations, churches and other religious organizations, the voluntary fire figthers, etc…

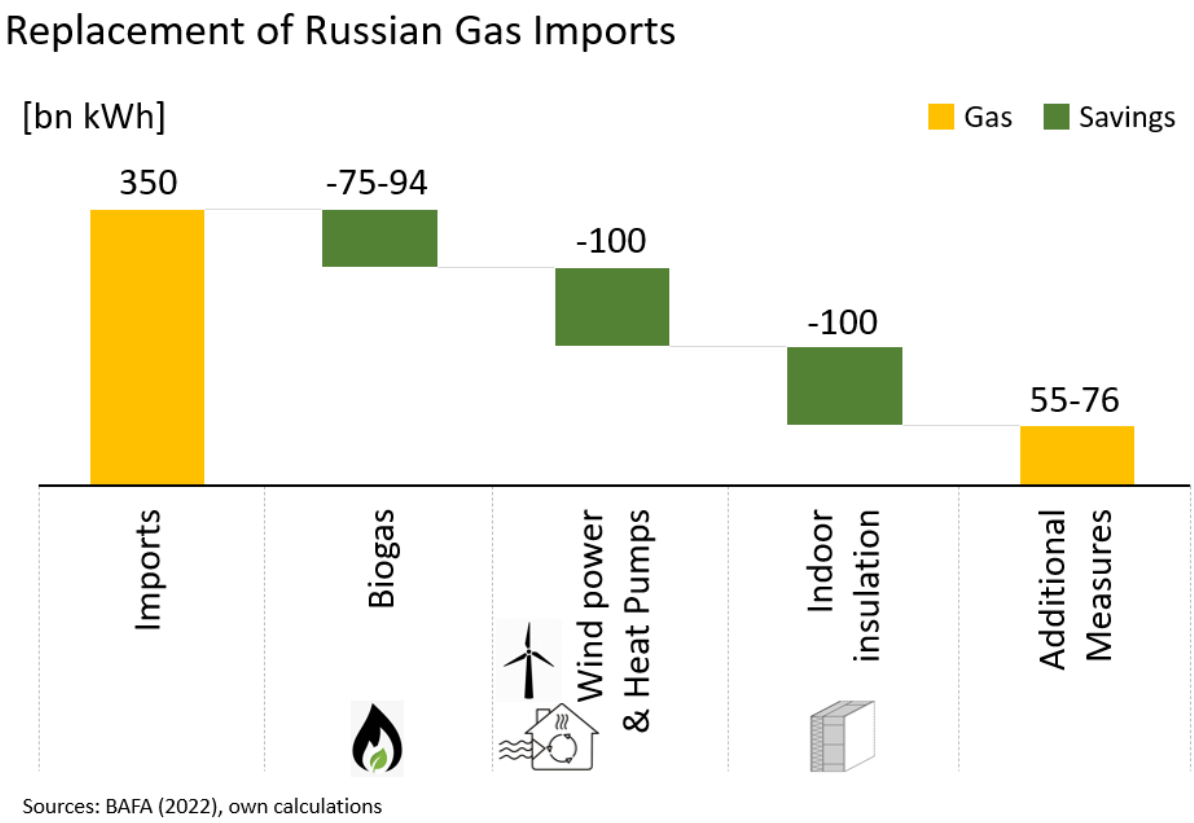
In order for organizations and people to show up, a national insulation league is suggested, with everybody able to participate with points and medals awarded for each insulated additional home.

Financing

The total costs for 3.3 Million **Energy-Independence-Premiums** and 4.8 Million **Indoor-Insulation-Premiums** amount to approx.. **40 BN Euro**. However, the same amount of costs has been saved within 3 years only, which is an annual 10 BN Euro in heating cost savings alone, forever.

Summary

All described measures are „**no-regret**"-measures, that pay off economically anyways, it`s a no-brainer.
The **TOP-3-measures** alone have the potential to each replace almost 1/3 of Russian fossil natural gas imports.



Source: Energy data BMWK (Bundesministerium für Wirtschaft und Klimaschutz, 2022)*, own calculations*

Grafic B: *TOP 3 measuares for replacing Russian fossil natural gas imports*

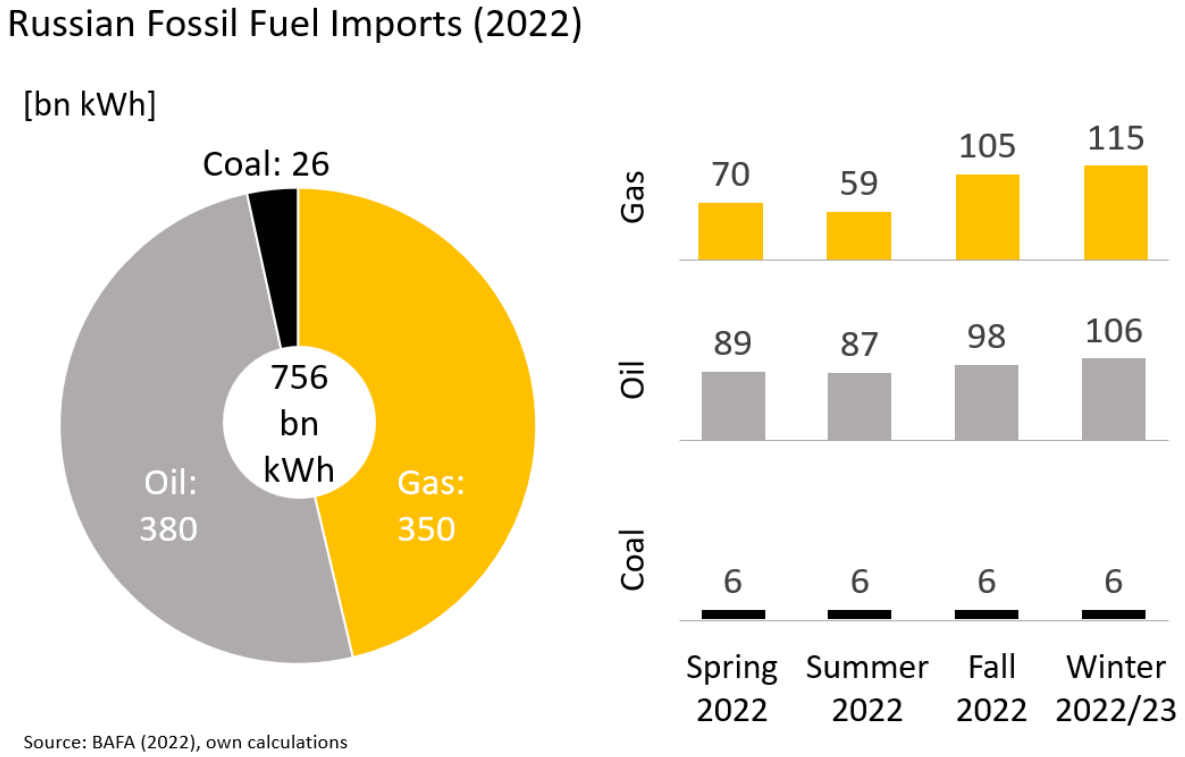
1) Connect existing **biogas plants** to the gas pipelines
2) Replace 3.3 Million gas furnaces with 330,000 **heat pumps** (1:10) & "type-open" new wind turbines to power them
3) **Indoor Insulation** of 4.8 Million homes with a simple home hardware do-it-yourself-approach

Results

Energy Imports from Russia

Current fossil energy imports from Russia are depicted in table and grafic 1a:

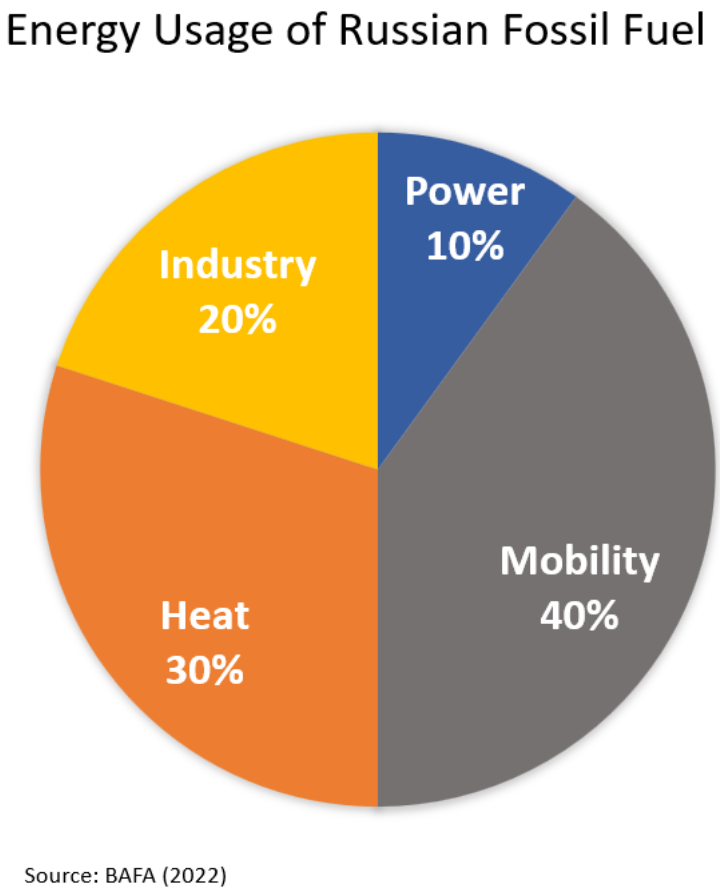
Russian Energy [BN kWh]	Spring	Summer	Autumn	Winter	Sum
Gas	70	59	105	116	350
Oil	89	87	98	106	380
Coal (electricity)	6	6	6	6	26
Sum	166	153	210	228	756



Source: BAFA (2022), own calculations

Table and Grafic 1a: *End energy consumption of fossil fuels from Russia*
Depicted is the end energy consumption in quarterly resolution from Spring 2022 until Winter 2022/23. Numbers may show rounding differences.
Sources: Energydata BMWK (2022) (Bundesministerium für Wirtschaft und Klimaschutz, 2022); own calculations.

In 2021, Germany imported about 55% of it`s fossil natural gas from Russia. During the study, the total amount has been decreasing to about 40% by March 2022 (350 BN kWh), and, most recently to 35% (Bundesministerium für Wirtschaft und Klimaschutz, 2022). The Study assumes 350 BN kWh. Additionally, Germany has imported oil (380 BN kWh), and coal (26 BN kWh) from Russia in previous years.



Grafic 1b: *Fossil Energy Use from Russia*
Sources: Energydata from BMWK (Bundesministerium für Wirtschaft und Klimaschutz, 2022), own calculations

Energymix Germany
Russian fossil fuels are assumed to be used on average according to the German energy mix, i.e. 10% for power generation, about 40% for transportation, 30% for home heating, and, about 20% for industrial purposes, mostly natural gas, as can be seen in the adjacent graphic (Bundesministerium für Wirtschaft und Klimaschutz, 2022)

Energy Savings

The basket of measures detailed further below can completely replace Russian fossil fuels by Autumn (Table and Grafics 2a).

[BN kWh]	Energy	Spring	Summer	Autumn	Winter	Sum
Bundle of measures	Nat gas	9	42	120	179	350
	Oil	65	69	107	138	380
	Power	-2	3	8	17	26
Balance	Gas (nat / bio)	-61	-18	15	64	0
	Oil	-24	-17	9	32	0
	Power	-9	-4	2	11	0
Russian Imports	Nat gas	0	0	0	0	0
	Oil	0	0	0	0	0
	Power	0	0	0	0	0

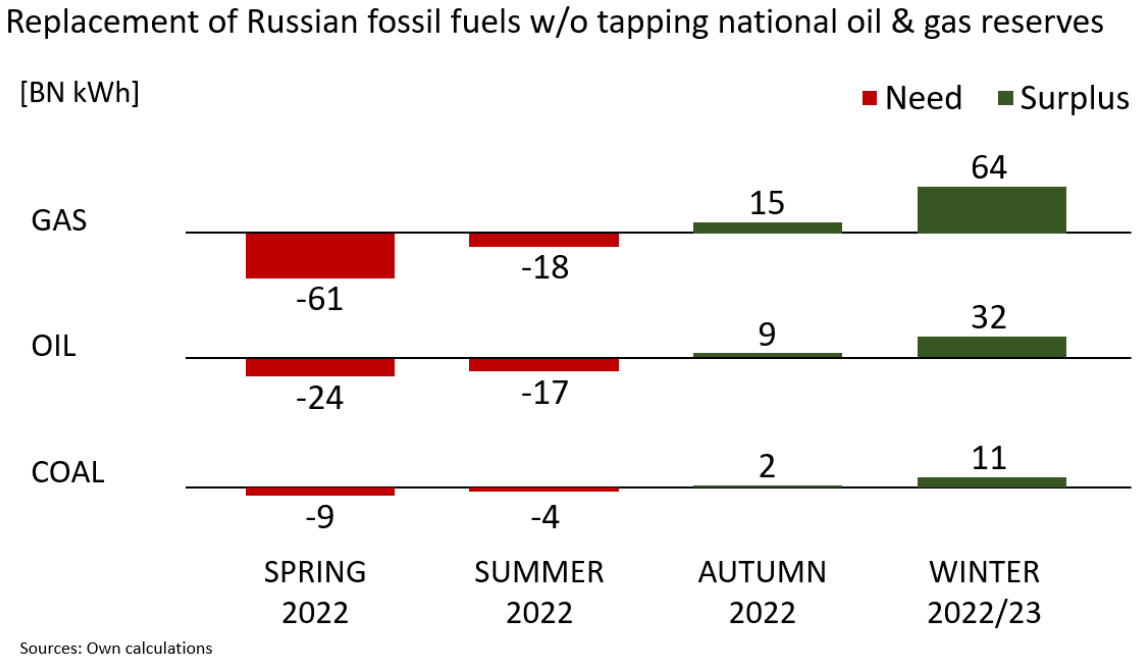


Table and Grafic 2a: *Quarterly balance based on Energy Savings and Renewable Energy installations* ***without*** *recurring to the national oil and gas reserves*

The basket of measures is effective because of massive energy savings in Autumn and Winter during the heating season, and, due to accelerated installations of renewable energy, most notably wind energy for power in the Winter.
The quarterly balance shows that it is possible to replace all Russian fossil fuels by Autumn already (black numbers in Table 2a). However, it is not yet possible in Spring and Summer which show deficiencies for all energies (red numbers in Table 2a).

In the event of an **immediate stop** of Russian energy deliveries, Germany could **substitute** Russian energy completely by temporarily opening up it`s national oil and gas reserves in Spring and Summer, see the balances in Table 3b. These would later on be replenished.

[BN kWh]	Energy	Spring	Summer	Autumn	Winter	Sum
Bundle of measures	Nat gas	9	42	120	179	350
	Oil	65	69	107	138	380
	Power	-2	3	8	17	26
National Oil & Gas Reserves	Nat gas	-61	-18	15	64	0
	Oil	-24	-17	9	32	0
	Power	-9	-4	2	11	0
Balance	Gas (nat / bio)	0	0	0	0	0
	Oil	0	0	0	0	0
	Power	0	0	0	0	0
Russian Imports	Nat gas	0	0	0	0	0
	Oil	0	0	0	0	0
	Power	0	0	0	0	0

Table 2b: *Quarterly balance based on Energy Savings and Renewable Energy installations* ***with*** *temporarily recurring to the national oil and gas reserves*

Especially in the winter time would the massive energy savings (120, and, 179 BN kWh, respectively) allow the oil and gas reserves to be replenished from ongoing non-Russian fossil fuel supplies. Due to the increase in EVs and electrifications, the study shows that slightly more power is necessary which can be supplied for by reducing power exports, or, a temporary use of reserve power plants.

National oil and gas reserves
The national Oil reserves amount to 22.6 Million Tons of crude oil which is about 262 BN kWh. The temporary use of such reserves, i.e. 17 BN kWh for the summer quarter, which amounts to less than 10%, and, therefore seems possible (Table 2a).

The same holds true for the national gas reserves which are currently filled up to 60% (150 BN kWh), and increasing for the Winter. A temporary use of such reserves seems to be doable as well. Specifically, the ask is for 17 BN kWh for the Summer quarter, which is about 7% of the gas reserves, however, it is about 11% of the current filling status which is more than half full (Bundesnetzagentur, 2022).

No use of the National oil and gas reserves
Using the national oil and gas reserves may not be a political option, given concerns about energy security, i.e. filling up the reserves for next winter as quickly as possible.
In any case, Russian fossil fuel can completely be replaced by Autumn, as Grafic 2a show.

Details

A basket of measures was designed to increase renewable energy production, and to save energy in private homes and to reduce private transportation, without affecting industry production at all. The individual measures are listed in Table 3 and Grafic 3 below.

[BN kWh]	Measures	Energy	Spring	Summer	Autumn	Winter	Sum
"No-regret" Measures	E-Mobility	Oil	5	5	5	5	21
	"every 5th ride"	Oil	19	20	22	23	82
	Renewable Energy Additions	Power	2	7	21	41	70
		Biogas (ex)	1	25	25	25	75
		Heat	0	1	4	10	15
	Wind power & heat pumps to „cut off gas for every 6th home“	Nat gas	3	8	38	56	105
		Oil	1	1	2	4	8
	Indoor Insulation „every 4th home“	Nat gas	0	2	38	60	100
		Oil	0	1	26	41	68
	Home heating: Reduce temp by 2°C	Nat gas	1	3	10	23	37
		Oil	1	2	7	16	25
Additional Measures	Home heating: Reduce temp by 4°C	Nat gas	4	3	7	10	24
		Oil	3	3	6	8	19
	Speed limit 110/80/30km/h	Oil	4	4	4	4	17
	"every 3rd ride“	Oil	33	33	33	34	133
Net effect		All	77	118	247	359	800
Additional Power	Heat pumps, EVs etc…	Strom	4	4	12	23	44
Net effect		All	72	113	235	335	756

Table and Grafic 3: *Effect of Measures*
Depicted is the increase in renewable energy (black numbers in table), and, energy savings (red numbers in table). The sum of both values is the combined effect of the measures.

The basket of measures consists of two types of measures. Firstly, „No-regret“-measures, which are economically viable anyways (see “No-regret” measures in table 3), and, additional measures necessary if all original fossil fuel imports from Russia are supposed to be substituted, including the ones that in the meantime have been diversified (see “Additional Measures” in Table 3).
The Additional Measures consist of further reducing private traffic by “every 4th ride”, reducing home heating not only by 2 degrees, but by 4 degrees Celsius. In addition, a temporary speed limit is considered with 110 km/h on Autobahn, 80 km/h outside of, and, 30 km/h inside of towns and cities.
All the measures cause a slight increase in electricity needs by 44 BN kWh, especially for EVs and heat pumps, as depicted in Table 3.

The following chapter describes each sector`s measures in detail, including, but not limited to calculation details, and, viability aspects.

Transportation

One of the fasted measures is to switch inner city transportation to bikes and E-bikes. The assumed amount is 49 BN kWh which is equivalent to 12% of all individual transport by car.

As a result the most inefficient car traffic is reduced, i.e. less than 3 miles trips with associated comparatively high emissions (Ahrens, Becker, Böhmer, Richter, & Wittwer, 2013). In addition, such reduced traffic opens up additional bike lanes, thereby increasing quality of life and tourism.

A particularly high contribution is avoiding „every 5th ride" saving 82 BN kWh (Table 3), approximately equivalent to the amount of leisure trips. However, there are other ways as well to avoid „every 5th ride" like public transportation, one day home-office, ride-sharing etc…

The remaining transportation will ideally be with EVs. This study assumes 1 million additional EVs within 12 months, ideally efficiently shared by ride-sharing (Table 3, Row 3). However, ride-sharing in Germany requires changing the Personenbeförderungsgesetzes which currently effectively prohibits Uber and others.

A temporary speed limit on the German Autobahn is not saving much energy, just 17 BN kWh or 2%, but it can save energy immediately.
Once transport savings and EV adoption has increased, the speed limit could be lifted (Ahrens, Becker, Böhmer, Richter, & Wittwer, 2013)[2].

The following box lists alternatives to avoid „every 5th ride".

Implementation options / 20% savings in private vehicle transportation

- The Netherlands and Denmark show us that it is possible to use **bikes** and **E-bikes** for much of the inner city transportation, thereby saving approx. 20%, or, "every 5th ride" (Umweltbundesamt, 2013).

- Using **public transportation** has the potential to save „every 5th ride" as well. The newly introduced 9-Euro Ticket for one month public transport nationwide should be extended beyond the initial 3-months-trial period.

- Once per week **Ride-Sharing** does also have the potential to save „every 5th ride"

- **Home-Office** is another solution that has been popular during the pandemic. One day home office per week also has the potential to save "every 5th ride"

- **Touristic rides** also avoid approx. 20% of private transportation (Gerike, 2019).[3]

[2] Private transportation end energy use in Germany is about 411 Mrd. kWh (Umweltbundesamt, 2013)
[3] Touristic rides account for approx. 20%

Calculations / Energy savings by 1 Million EVs

Assumptions

Fuel consumption combustion car	70 kWh/100 km (equivalent to 7 liters/100km)
Power consumption EV	15 kWh/100 km (equivalent to 1.5 liters/100km)
Annual mileage	30,000 km
Energy for 1 Million combustion cars	21 BN kWh (2.1 BN liters gasoline)
Energy for 1 Million EVs	4.5 BN kWh

Heating

Three measures were evaluated to reduce heating costs. Firstly, reducing the average room temperature to 20 degrees Celsius ("2 °C less"). Secondly, indoor insulation with an easy home hardware do-it-yourself approach, and, thirdly, the replacement of fossil natural gas furnaces by heat pumps.

There is no scientific data on the average room temperature in Germany, so for illustration purposes only we are assuming this to be 22 degrees which would be reduced by 2 degrees to 20 degrees Celsius.

Indoor insulation is described in detail in an attachement to this study.

Calculation / Reducing room temperature to 20 °C („2 °C less")

Assumptions:

Energy savings per 1°C lower room temperature	6% (31 BN kWh)
Energy savings per 2°C lower room temperature	12% (62 BN kWh)

Note: A reduced room temperature is generally considered to be healthier („avoiding dry air").

Calculation / Indoor Insulation

Assumptions for indoor insulation[4] for homes or apartments:

Energy savings goal	100 BN kWh
1) Homes	
Annual heating (built before 1995)	30,000 kWh / year
Savings by indoor insulation	21,000 kWh / year (70%)
No. of homes	4.8 Million („every 3rd home")
Energy savings	100 BN kWh
OR:	
2) Apartments	
Annual heating (built before 1995)	15,000 kWh / year
Savings by indoor insulation	10,500 kWh / year (70%)
No. of appartments	9.6 Million („every 4th household")
Energy savings	100 BN kWh

Note: Germany has about 42 Million households, of which there are about 15 Million individual homes.

The study assumes an additional insulation of 1.2 Million homes with heating oil furnaces, saving an additional 41 BN kWh heating oil.

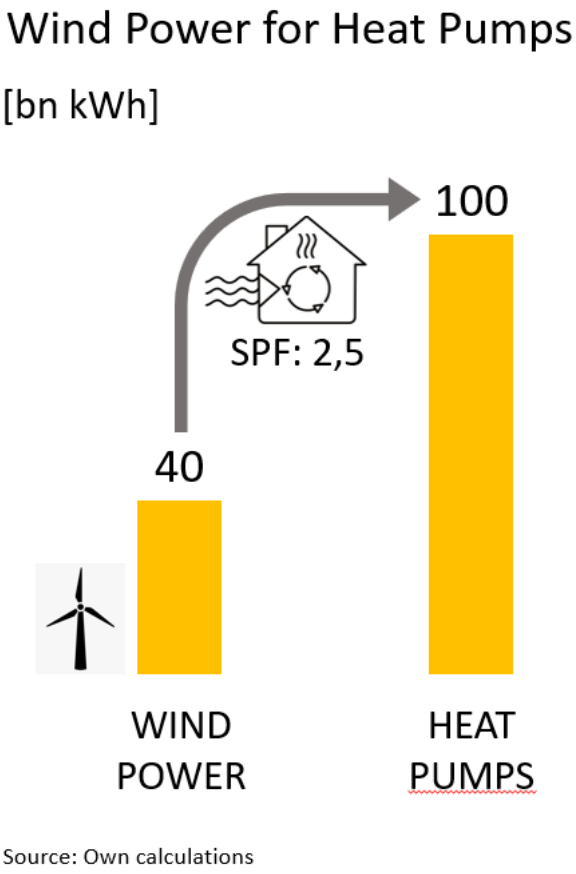
Heat pumps

The study shows that 330,000 heat pumps can heat 3.3 Million homes which saves approx. 100 BN kWh energy, see detailed calculations in the attachment.

The exact amount used in the study is saving 105 BN kWh fossil natural gas, and, an additional 8 BN kWh savings in heating oil. The total amount for the study is 113 BN kWh as can be seen in Table 3.

[4] Assumption for indoor insulation: 250 kWh/m2*year for homes built prior to 1995.

The necessary power for the heat pumps can be supplied by installing new wind farms. The study assumes simple water/air heat pumps with a seasonal coefficient of performance (SCOP) of 2.5 (for the winter time, which is relevant here). Therefore 40 BN kWh of wind power result in 100 BN kWh home heating (SCOP 2.5 as mentioned) as can be seen in Grafic 3b.



Source: Own calculations

Grafic 3b: *40 BN kWh of new wind power can produce 100 BN kWh in home heating*
The assumed seasonal coefficient of performance (SCOP) is 2.5 for the relevant winter time.

Calculations / Heat pumps

Assumptions[5]:

Energy savings goal for fossil natural gas	100 BN kWh
3) Homes	
Annual heating energy (built before 1995)	30,000 kWh / year
Heat pump for home	30,000 kWh / year
No. of homes	3.3 Million („every 5th home“)
No. of 60kW heat pumps (running around the clock)	330,000 heat pumps
Energy savings	100 BN kWh fossil natural gas
OR:	
4) Appartments	
Annual heating energy (built before 1995)	15,000 kWh / year
Heat pump for appartment	15,000 kWh / year
No. of appartments	6.6 Million („every 6th apartment”)
Energy savings	100 BN kWh fossil natural gas

Note: Germany has about 42 Million households, of which there are about 15 Million homes.

Modernizing Homes

About 1% of German homes are energetically modernized every year. Because the contribution is only 10-15 BN kWh, it has not further been considered in this study. In addition, there are labor and supply chain constraints, so it is not clear if this goal can even be reached this year. Nevertheless, it is a contribution for future decarbonization goals.

Air Ventilation Systems

About 1 million class rooms, board rooms and waiting rooms can be retrofitted with simple air ventilation systems. The indoor air is efficiently interchanged with a simple counterflow heat exchanger. Two simple electrical motors let outside air to flow in, and indoor air to flow outside. The air is furthermore filtered. The counterflow heat exchanger makes the system extremely energy efficient with a COP of 50!

However, due to supply chain issues and labor shortages, the study has not considered these air ventilation systems for the next 12 months. Nevertheless, these systems can contribute to energy efficiency greatly in a decarbonized world.

Health benefits
In addition, these air ventilation systems allow for controlling germs and fatigue prone CO2 in class rooms, and, can prevent students from learning with open windows in pandemic times in freezing winters as has widely happened in Europe.
In seasonal flue times these air ventilation systems can control the virus concentration in the classroom better by exchanging the air 4x an hour, as prescribed in Covid-19 times as well. In

[5] Calcuations for heat pumps: A standard air/water heat pump has 14,9 kW. If operated around the clock, it can produce 14,9 kW * 5110 h = 76.139 kWh during an assumed 7 months heating period in winter and fall. This is enough heat for 5 apartments, assuming 15.000 kWh for each apartment. With increasing the capacity 4 fold to 60 kW (or doubling the standard 28kW heat pumps), such a heat pump can supply heating for 20 apartments or 10 homes. 330,000 of such heat pumps can therefore heat about 3.3 Million homes or, alternatively, 6.6 Million apartments.

addition, these systems have filters that can filter allergens from the air in springtime, reducing hay fever and other allergy symptoms in the classroom.
Last not least, teachers are the only group of professionals that are excluded from the Labor Act defining clean air conditions for work, because CO2 levels in classrooms are typically beyond such safety levels. Air ventilation systems can operate with a CO2 sensor, exchanging indoor air with fresh air as needed.
Air ventilation systems can furthermore be used to precool classrooms at night in summer, avoiding costly AC-systems in upcoming hotter summers.

Note: Historically, this is how Amory Lovins controls summer heat in his first passive home of the world built in 1983 (mentioned in the foreword to the study above). Summer night precooling with simple air ventilation systems, thus avoiding costly AC-systems.

Calculations / Air Ventilation Systems

Assumptions (Stuckmann, Lüftungsanlagen für Schulen & Kitas im Märkischen Kreis, 2021):

Electricity use by Compact-Air-Ventilation-Systems

Electricity of the 2 ventilation motors (less energy than illuminating the class room)	2x75 W
Electricity per day (10h)	1.5 kWh
School heating days	100
Electricity per year	150 kWh

Energy savings

Energy savings per (class) room	7,500 kWh per year
No. of class-, board-, waiting rooms	1 Million
Savings	7.5 BN kWh

Savings ($)

Electricity rate	25 cents / kWh
Electricity costs per (class) room	38,- per year
Heating costs (fossil natural gas)	10 cents / kWh
Savings per (class) room	750,- per year
Net savings per (class) room	750,- – 38,- = 712,-
Net savings 1 M (class) rooms	712,- x 1 Million = 0.75 BN Euros

Note: With using air-ventilation-systems for summer night precooling of (class) rooms as well, therefore avoiding costly AC systems, the annual net savings can easily exceed 1,000,- Euros per (class) room.

Note 2: Germany`s KfW bank finances Air-Vent-Systems as part of it`s home energy efficiency programs with **100% loans** at pretty much zero interest rates, and, an additional 20% rebate is available as well, www.kfw.de/beg. In other words, an Air-Vent-System „***costs nothing & pays off by savings alone***“, i.e. saves heating costs for years to come.

Viability / Air-Vent-Systems (class rooms, board rooms, waiting rooms)

The following criteria were evaluated:

Construction time	1 day / to be installed in the upper class room window or by core drilling through the wall	
No. of Air-Vent-Systems	1 Million	ATTENTION: Supply chain
Personal needed	Craftsmen/-women	ATTENTION: Labor shortages

Air-Vent-Systems are amongst the most efficient energy saving appliances with a coefficient of performance (COP) 50!
Only solar passive homes are better as they do not need any fossil heating energy at all anymore, as Amory Lovins has shown.

Efficiency-Champion / Air-Vent-Systems

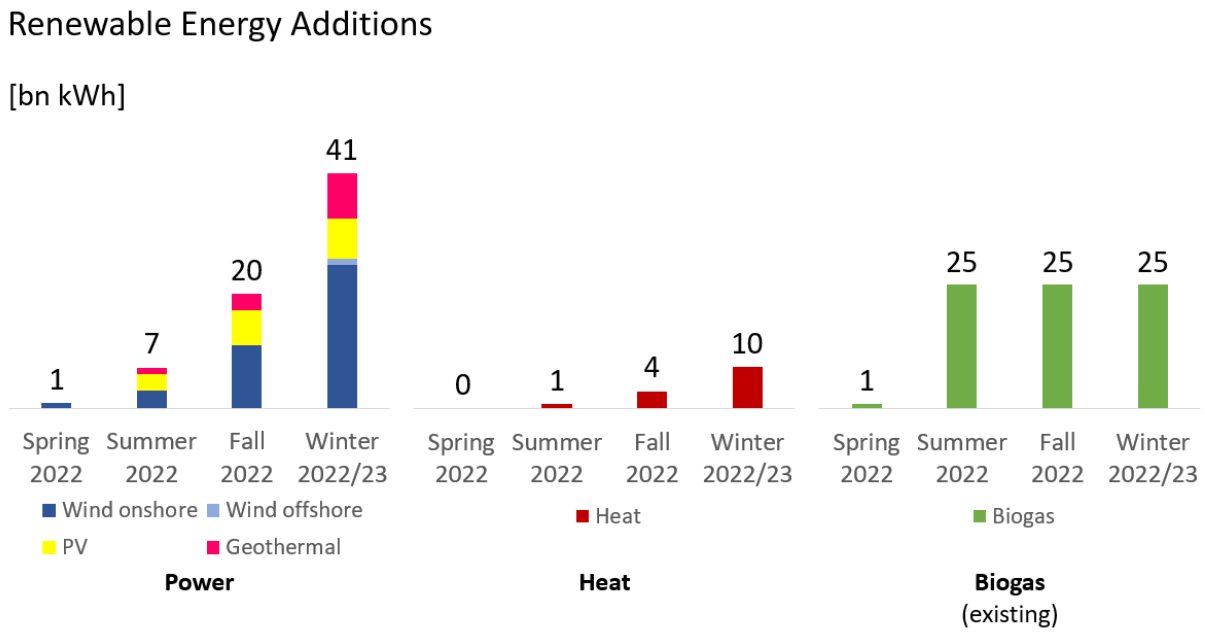
Electricity for 2 ventilation motors	150 kWh / year
Heat energy savings	7.500 kWh / year
Efficiency-factor	7.500/150 = **50**

1 kWh electricity saves 50 kWh heating energy! **Efficiency-Champions!**

Renewable Energy

With a fast expansion of renewable energy, 160 BN kWh can be added within 12 months. This includes connecting the 10,000 **existing biogas plants** to the **gas pipeline** network to supply 75-94 BN kWh of biogas, see Table 4. Biogas plants can be used for biogas production only in Spring and Summer outside of the heating season. They can produce power and heat especially in winter and fall. On the long run, biogas plants should run with maximum flexibility to fill in the power gaps for renewables, heating especially in local heating networks during the heating season, as well as producing biogas for the industry otherwise. With biogas plants producing biogas into the gas pipeline system, there is no further need for any new peaking gas plants in a 100% renewable energy system (Bundesverband WindEnergie, 2021).
New cheap renewable energy accounts for 70 BN kWh, mostly wind energy for powering heat pumps in the Winter.

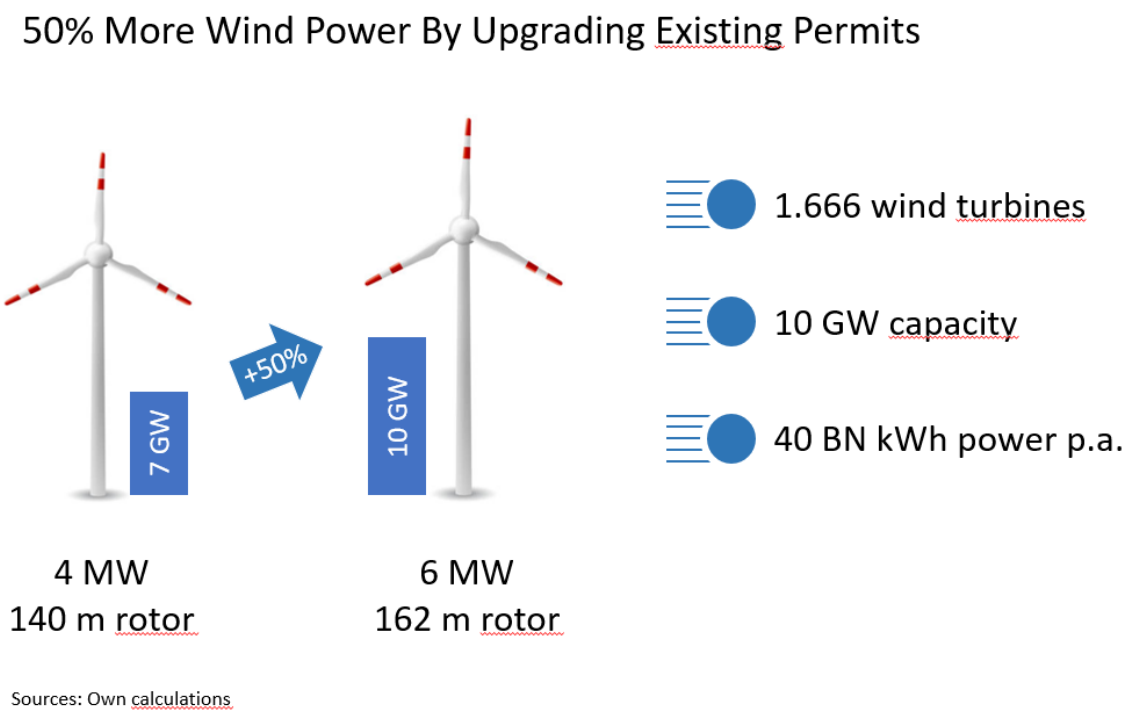
[BN kWh]	**Energy**	**Spring**	**Summer**	**Autumn**	**Winter**	**Sum**
Power	Wind onshore	1	3	11	25	40
	Wind offshore	0	0	0	1	2
	Solar PV	0	3	6	7	16
	Geothermal	0	1	3	8	12
Heat	Geothermal	0	1	4	10	15
Gas	Biogas	1	25	25	25	75
Sum		3	33	49	75	160



Source: Own calculations

Table and Grafic 4: *Renewable Energy for replacing electricity, heat and fossil natural gas*
*Geothermal contains also other renewable sources like solar thermal and biomass from gardening, as well as classical home modernizations.

The key for wind energy is opening up permits for „type-open“, i.e. 2,000 already permitted wind turbines would be allowed to switch to **state-of-the-art 6 MW wind turbines** prior to installations, i.e. instead of installing the old 4 MW and smaller turbine types submitted to permitting years ago into the rigid German permitting procedures, taking years for approvals. With this **abbreviation** of „**type-open**“ **permits**, **50% more wind energy** can be produced in the short term as depicted in Grafic 4a, below. The study assumes the installation of 1,666 of the 2,000 already permitted wind turbines within a 12 months timeframe, providing 40 BN kWh, especially for heat pumps in Fall and Winter.



Grafic 4a: *Expanding wind power production by 50% with „type-open“ permits*

Viability / Installation of 1.666 wind turbines in 12 months

„Type-open“ Permits
This can be accomplished by changing §15 BIMSCHG with inserting one sentence: „a change in wind turbine type is a non-material change, as long as it`s immissions stay the same (i.e. immissions from sound and shadow)”. With this single sentence, a change in turbine type does not require a new permit, but does only require an obligatory disclosure prior to start of construction.

Wind turbine manufacturers
The delivery of 1,666 wind turbines of the 6MW-class within 12 months is possible according to inquires with wind turbine manufacturers. It does however require a re-prioritizing deliveries, and, is subject to supply chain availability.

Installations
The installation of 1,666 wind turbines in Germany within 12 months seems possible, as a similar number was installed in 2016 and 2017 already, most of them in the second half of the year.

Outlook: New permits 2022
According to experts about 1,000 wind turbines are expected to receive permits in 2022. In addition, after 10 years of blocking any changes, the new Secretary of Transportation has recently changed the mandatory distance of wind turbines from VOR-Radar systems at airports with the potential of an additional 5 GW of wind turbine permits, and, if type-open, these could be boosted by 50% to 7.5 GW. However, these additional permits have not been considered in this study, given longer lead times for the installations of not yet permitted wind farms.

Calculation / Annual output wind energy	
Installed wind turbines in Germany, approx.	50 GW (2021)
Annual production of wind power, approx.	100 BN kWh (2021)
Annual production per wind turbine, approx.	2 Million kWh / MW
State-of-the-art Wind turbines (6-MW-class)	
Annual production per wind turbine (new) (subject to onsite wind potential)	3-5 Million kWh / MW
Assumption annual production per wind turbine (new)	4 Million kWh / MW
Assumption installed capacity wind turbines (new)	10 GW
Assumption No. of wind turbines (new 6 MW)	1.666
Sources: (Bundesverband WindEnergie, 2021)	

Biogas

The existing 10,000 biogas plants can inject 75 - 94 BN kWh of biogas into the pipeline network. The study assumes 75 BN kWh.

Of the existing 10,000 biogas plants in Germany, only about 200 have been connected to the pipeline network (Stiftung Energie und Klimaschutz, 2019), and very few have been flexibilized to complement wind & solar production, by filling in the gaps. Most biogas plants run 8,000 hours per year, and even causes a shutdown for wind and solar plants at times of high renewable production. Therefore, biogas plants should be fully flexibilized to rather support renewable energy production of it`s two main pillars, cheap wind and solar energy, and, simply produce biogas (without going through cogeneration) when such grid support is not needed. Especially in the Winter, biogas plants can also support local heating networks through the cogeneration of power and heat.

Note: Biogas plants should only be allowed to use maneures, compostables, green cuts, leaves in the Fall, and used vegetable (french fries) oil. Corn should not be allowed, also to not incentivize any more deforestation in the rainforests, as discussed with the EU commission (Beddington, 2017).

If biogas plants were to be flexibilized for power grid support, they would only need to run approx. 2,000 hours per year with a combined capacity of about 30 GW which would allow the mobilization of 400 GWh power within hours. To put this into perspective, this is about 10 x the storage of all available pump storage facilities in Germany. These existing biogas plants furthermore have about 120 BN kWh of biomass stored onsite which can be used as needed. This is a similar order of magnitude compared with the national gas reserves, i.e. the gas caverns (237 BN kWh – when filled up) (Energy Watch Group, 2022).

Calculations / Connecting biogas plants to the pipeline network

No. of existing biogas plants	10,000
Electricity production (2021)	28 BN kWh
Assumption: Removal of current quantity limitations	33 BN kWh (+15-20%)
Assumptions: New-built 2022	5 BN kWh
Assumption: Annual electricity production	38 BN kWh

Injection of biogas into pipeline network 38 BN kWh x 3 = 114 BN kWh biogas

Spring & Summertime

Biogas plants max. (all plants, 100%)	57 BN kWh
Assumption for Study	32 BN kWh

Autumn & Wintertime

Biogas plants max (all plants, 100%)	57 BN kWh
Minus 25% (plants that provide external heating services)	14 BN kWh
Available biogas for pipeline injections (75%)	43 BN kWh

Assumption: Annual biogas for pipeline injections 32 BN kWh + 43 BN kWH = 75 BN kWh
The study assumes 75 BN kWh of biogas injection into the gas pipeline network.

Viability / Connecting biogas plants to the pipeline network

Technical viability

No. existing biogas plants	10,000
No. of furnace installation firms	50,000

(Zentralverband Sanitär Heizung Klima, 2022)

Viability timelines

Planning (best case)	1 week
Permits	3 months
Assumption: Permits (accelerated)	1 week / LNG-Terminal permits took 4 days
Assumption: Installation gas tubes (technical)	2-6 weeks

Policy instruments

-biogas plants are currently operating under **quantity limitations**. These should be **removed** to allow for an additional 15-20% biogas production annually.

-change rules for connecting biogas plants to the gas pipeline network, **GasNZV §33 ff**: A connection application shall be **permitted within 1 week** (same text as in EEG for PV solar, but adapted to biogas plants / to date there is not timeframe given in GasNZV for obtaining a permit for biogas plants to connect to the pipeline network).

-The **connection cost limitations** should be expanded for **beyond 1 km**.

-the **gas-interconnection station** should be allowed within **1m x 1.5m**, as is the case in other European countries (e.g. in the Netherlands).

-the **technical work** of the connection should not only be allowed for the pipeline companies, but should **also be allowed** by any **qualified company**, as is the case in other European countries.

PV Solar

The study assumes an additional production of 16 BN kWh from new PV Solar installations.

Calculation / PV

Assumption: New installations (12 months)	20 GW (according to BMWK targets)
Annual production:	20 BN kWh
Assumption: Production (next 12 months)	16 BN kWh

Geothermal, solar thermal, biomass from gardens, building modernizations, else

The study assumes 12 BN kWh electricity from deep geothermal sources with 10 BN kWh heat cogeneration, and, an additional 5 BN kWh from near surface geothermal sources. This is less than 1% of the geothermal potential in Germany (Jain, Vogt, & Clauser, 2015) (Aghahosseini & Breyer, 2020) (Traber, Hegner, & Fell, 2021).
However, environmental safety concerns need to be evaluated (Stiller-Ludwig, 2022) which is why the study assumes additional renewable resources to contribute and replace any shortfalls:

The annual installation of solar thermal roofs in Germany is about 1.5 Million m^2, producing approx. 0.75 BN kWh solar heating (Solarwirtschaft, 2022). These annual installations can easily be doubled according to the German solar association, hindered however by labor shortages. Solar thermal contributions have not separately considered, but assumed included in the geothermal data in Table 4.
Biomass from gardening is also assumed included in the geothermal data in Table 4.

Additional Measures

The measures studied so far allow for a substitution of the annual Russian fossil fuel imports only, if some of it is diversified from other fossil fuel sources. In order to study a complete replacement of Russian imports by new renewables and energy conservation only, the study considers 3 additional measures ("Additional Measures"), as depicted in Table 3.

- a temporary speed limit with 110 km/h on Autobahn, 80 km/h outside of, and 30 km/h inside of towns and cities, resulting in savings in the amount of 17 BN kWh

- a temporary reduction of private vehicular traffic („every 4th ride", in addition to "every 5th ride"), saving every 3rd kilometer, because of mostly long distance travels, i.e. 110 Mrd. kWh

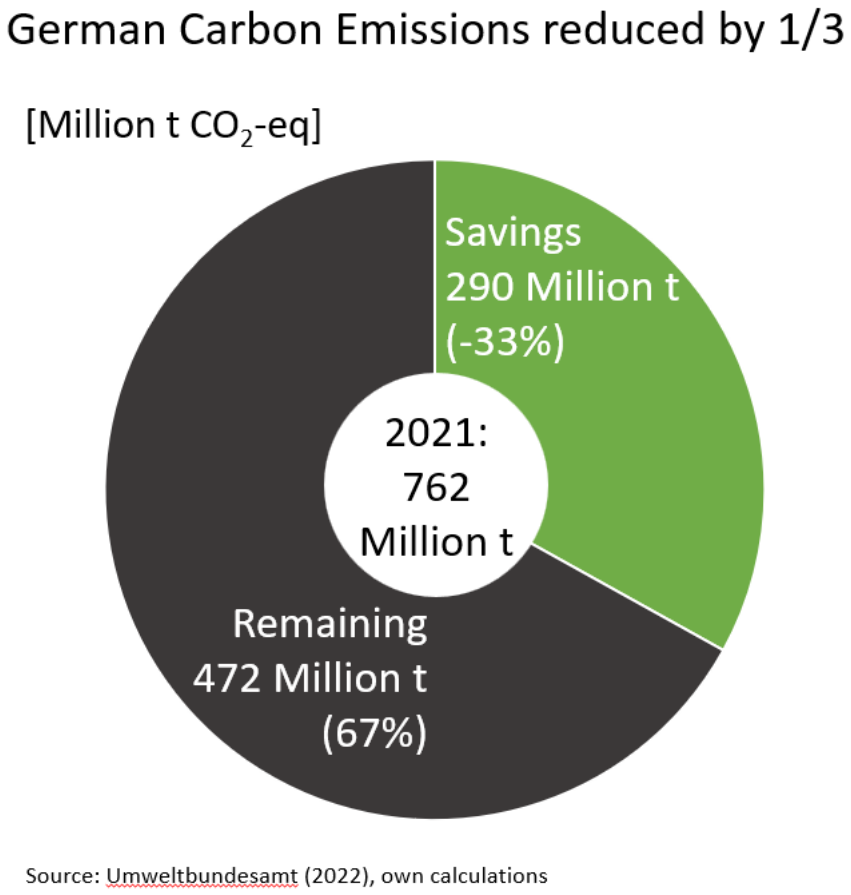
- reducing room temperatur by a further 2 degrees (i.e. 4 °C total reduction). The assumed room temperature is 18 °C, saving BN kWh. This value is less because the home insulations of the initial basket of measures have been accounted for.

Even with these Additional Measures it is not possible to replace Russian fossil fuel imports in Spring and Summer 2022, because most measures need time for implementation (red numbers in Table 2a/2b). The gaps can only be filled by a temporarily accessing the national oil and gas reserves, refilling them in Autumn and Winter, as described above and as can be seen in Table 2b, or, by diversifying with other fossil fuel imports which is not the objective of this study.

Effect on German Greenhouse Gas Emissions

The Measures described would **reduce** Germany`s **carbon footprint** by reducing greenhouse gas emissions **by $^1/_3$ within a year**, as depicted in Table 5 and Grafic 5.

Emissions [Million t CO2 eq]	**Spring**	**Summer**	**Autumn**	**Winter**	**Sum**
Nat gas	-2	-10	-30	-45	-87
Oil	-26	-28	-43	-55	-152
Power	1	1	-4	-9	-13
Sum	-27	-39	-77	-109	-252



Source: Umweltbundesamt (2022), own calculations

The Measures save an additional 52 Million tons of CO_2-eq emissions from the supply chain, like fossil natural gas infrastructure, that are not included in Table 5 or Grafic 5.
These supply chain emissions have not been included to allow for comparability with Germany`s commonly known greenhouse gas emissions by Umweltbundesamt which do not include such supply chain emissions neither.

Energy Independance for Germany (Outlook/Prof. Eicke R. Weber)

This study shows how Germany can replace Russian fossil fuels. However, this is only the first step towards Energy Independence.

The current **energy crisis** in Europe not only shows us how dependant we are from energy imports, but also from higher energy costs with resulting social tensions like the yellow-vests in France and other countries.

It is immanent to capitalism that economic crises initially result in lower energy consumption with associated lower energy prices, with some fossil fuel producers therefore going out of business. However, if the economy recovers with increased world energy demand, it simply takes years for new fossil fuel production to come online adding more supplies, and, hence, lower prices for energy.

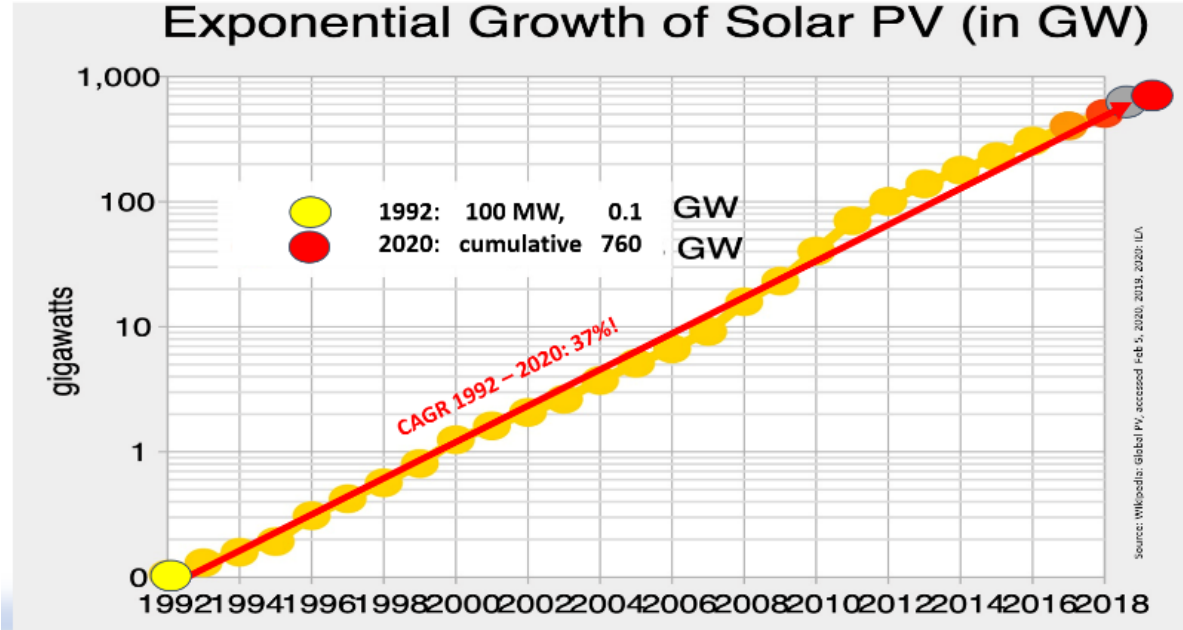
Furthermore, an energy crisis usually **destabilizes** a country as illustrated by **social unrest** in many countries around the world, including, but not limited to the recent street protests in Portugal and South America. Even in the US, republicans have started to sign up voters **at the pump** taken advantage of high gas prices.

An **energy crisis** can therefore not be avoided by diversifying fossil fuel sources. Only **renewable energy** can decouple us from future world energy trends and crises with associated high energy costs out of our control (Jenkins, 2022).

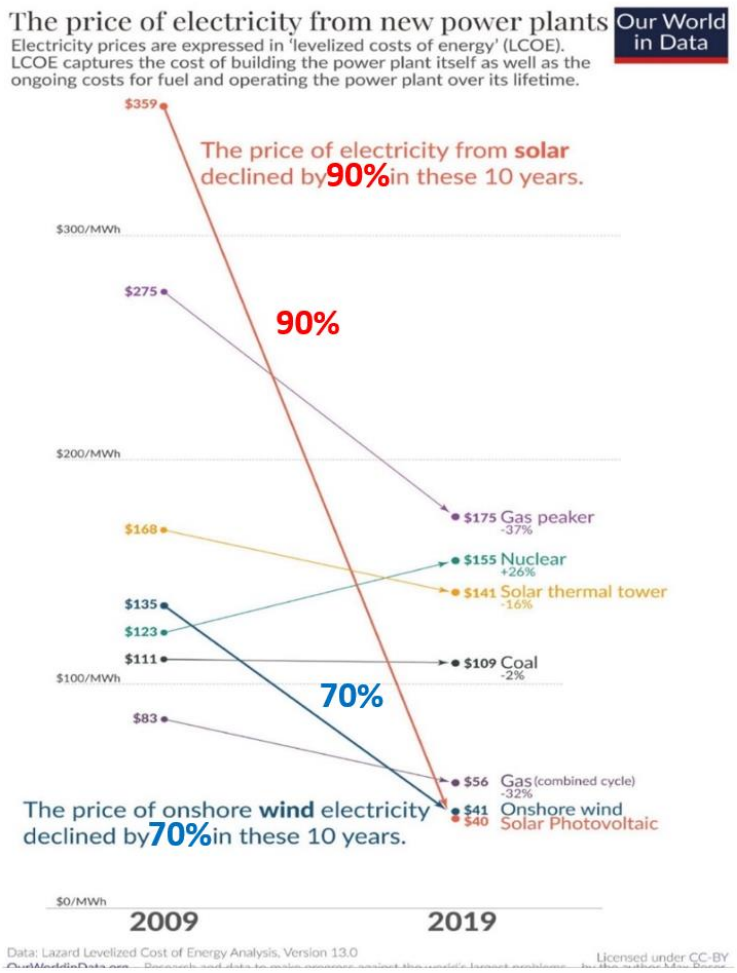
And that`s how we get to the **Energiewende**, the energy transition.
And that means fast-tracking domestic renewable energy installations for cheap **wind & solar** energy first of all, aside from sector coupling, and, green hydrogen for the industry.

We have seen **exponential growth** for **wind- & solar energy** (Grafic 6), with crushing prices as can be seen in Grafics 7 and 8.

Global Growth of PV Installations 1992 – 2020



Grafic 6: *Exponentiel Growth for Solar Energy, logarithmic scale*

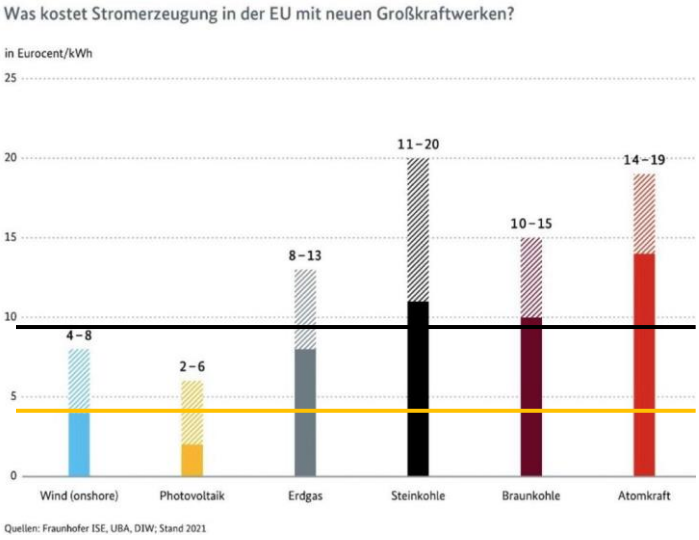


Grafic 7: *The price of electricity declined by 70% for wind, and, by 90% for solar energy.*
Sources: Lazard Levelized Cost of Energy Analysis Version 13.0

We have renewable energy at **1/2 the price**:

Costs per Megawatthour (MWh)
Gas- and Coal plants $80
Wind- and Solar farms $40
= 1/2 the price

Details
Gas plants $56 + Coal plants $109 = $165 /2 = $83, rounded $80
Wind turbine $41 + Solar PV $40 = $81 /2 = $40



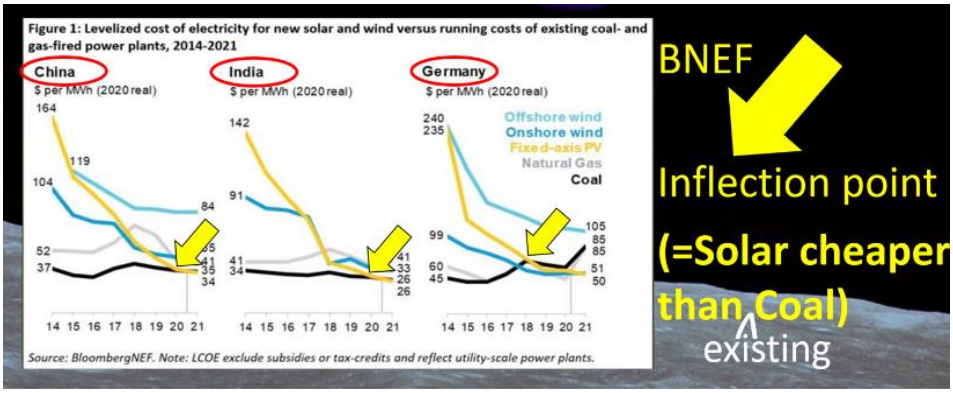
Grafic 8: *Renewable Energy at ½* ***the price*** */ Power generation costs in Europe*
Sources: Opening balance Robert Habeck, German Secretary of Economy and Climate (BMWK, 2022), own calculations

Costs per kilowatthour (kWh)
Gas- and Coal plants approx. 8-10c
Wind- and SolarPV approx. 4-5c
= ½ the price

Wind & Solar
= ½ the price

New Wind and Solar Farms are cheaper than running coal plants

Since 2017 it is cheaper for Germany to install new wind and solar farms than the running costs alone for existing, old and fully depreciated coal plants. The same is true for India and China (and the US since 2009) as depicted the the adjacent grafic from Bloomberg BNEF.

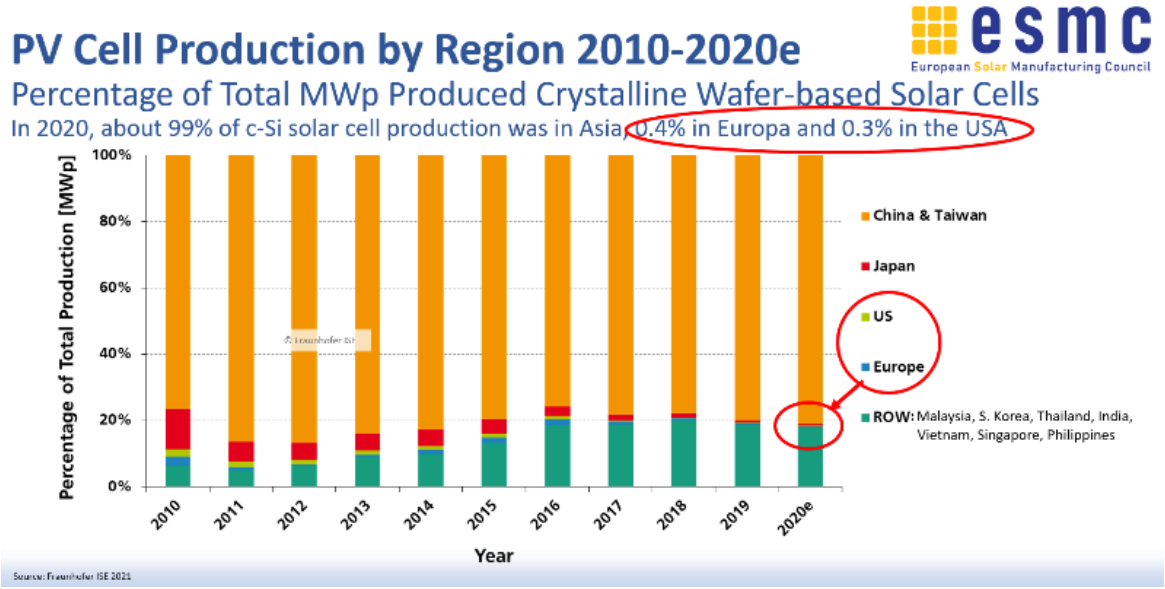


Grafic 9: *The Inflection point – new Wind- and Solar Farms are cheaper than even running coal plants*
Sources: BNEF, own grafics

99% dependance

While wind energy has to primarily fight with domestic problems like very long permitting procedures, it is solar energy that faces the risks of a 99% dependance from solar cell manufacturing in China and other non-western countries.

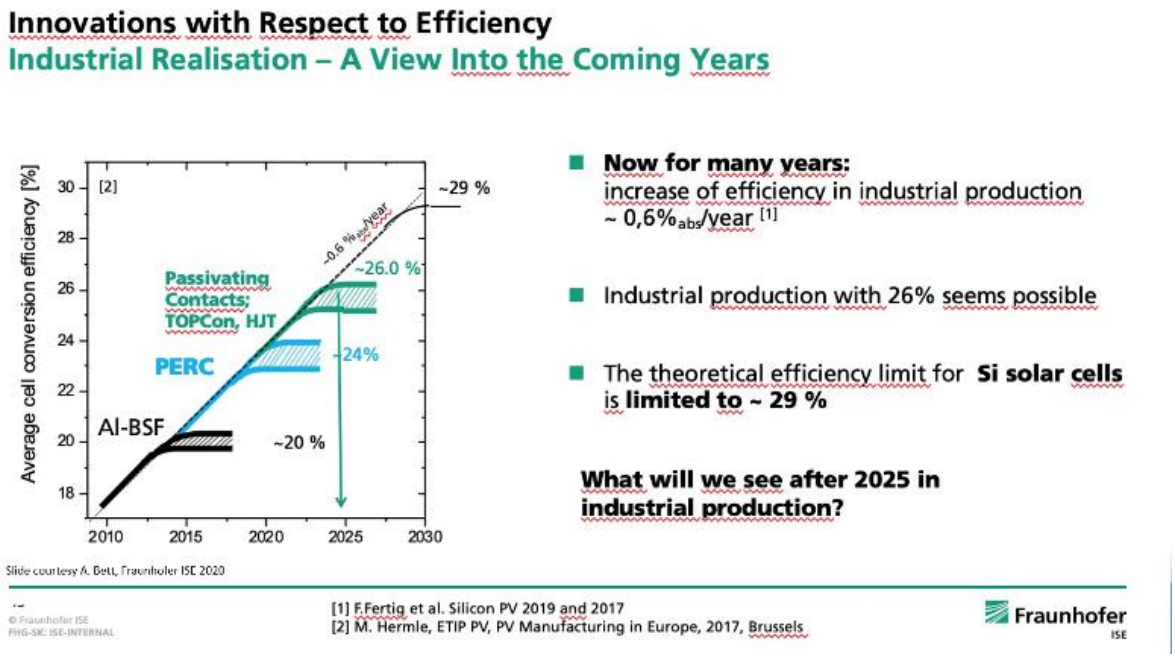
Grafic 10 shows that less than1% of the Solar cell production is located in the US or Europe:



Grafic 10: *Solar cell production in Europe and the US is less than 1%*

With 100% cheap renewable energy systems running mainly on wind and solar energy in the future, it is critical for the western world to control the supply chain for PV solar installations, especially solar cell manufacturing (for clarifications, this is not solar panel assembly, but rather manufacturing the core silicium cell itself).

Interestingly, we have a unique opportunity with the **new 3rd generation** of **solar cells** coming to market, the so called Hetero-Junctions (HJT) with up to 26% efficiency, as depicted in Grafic 11. We are leading in technology, and, Hetero-Junctions need new factories. The existing ones cannot easily be retrofitted. This is a **unique opportunity** for the **West** to re-enter solar cell manufacturing on equal footings with China.

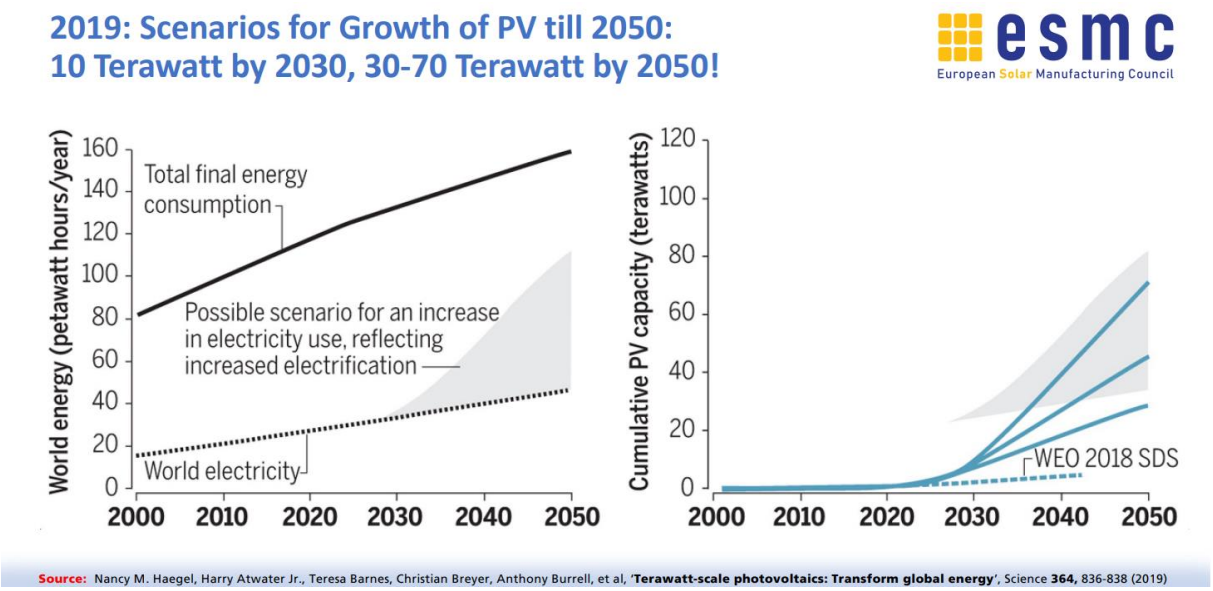


Grafic 11: *Efficiency of solar cells*
The new 3rd generation of Heterojunction (HJT) solar cells has a better efficiency of up to 26%.

In order to implement **Gigawatt-scale** solar cell manufacturing in Europe, the **EU commission** recently designated solar manufacturing an Important Project of Common European Interest ("**IPCEI**") creating a framework for political and financial support for manufacturing.
Batteries were designated an IPCEI as well a few years ago, to help European car manufacturers to transition into E-mobility.

Spain is now leading the Solar manufacturing IPCEI project. It would be desirable for the German Government to participate in this IPCEI as well, given the enormous task to supply Europe with cheap solar energy in order to lead Europe into energy independence.

The world market for PV solar is huge. Even though the world just recently celebrated it`s first **Terawatt day**, because the world has 1 Terawatt of Solar cells installed now, this is only the beginning. Grafic 12 shows that the total capacity needed worldwide is about 70 Terawatt (assuming the future electrification of the industry) with the Terawatt-Day we just celebrated being just 1-3% of it. The future of solar energy still lies ahead of us.



Grafic 12: *Exponential Growth expected for Solar PV in coming years*
Sources: (Breyer, 2021) (Ram, 2019) (Bogdanov, 2021)

With **cheap wind** and **solar energy** it will be possible to transition into 100% cheap renewable energy systems aiming for energy **independence** for future generations.

And, this is possible for Germany to even be accomplished by **2030-35** as two recent studies by **Tony Seba** and the **Energy Watch Group** have shown (Seba, 2022) (Energy Watch Group, 2019):

Tony Seba`s study is interesting, and gives **new perspectives** (Stuckmann, Interview mit Tony Seba, 2022):

Just imagine, what commodities at zero marginal costs can enable, according to Tony. The last **disruption** caused by **data with zero marginal costs** basically enabled everything from Google searches, social media, online newspapers, Apple and Amazon.

Finally, **cheap renewable energy** is probably the next commodity that comes in with **zero marginal costs** at times of plenty, according to Tony, opening up huge **new business models** for start-ups, like data did for Google and Amazon. Just image what you can do with free power!

However, this is also about **humanity**. Only the **extremely rapid** implementation of cheap **renewable energy** systems now may eventually allow us to still avoid the most dramatic consequences of our current path into catastrophic climate change, i.e. the **heat-age** coming.

It is crucial to build up decentralized **solar manufacturing** for future cheap solar energy supplies. We do not want to get out of Russian fossil fuel dependance, only to get into solar equipment dependance.

We need to **blast the chains** now, that have held us back in the fossil fuel world for too long, we need to finally open the door for renewable **freedom** energies.

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Appendix for political outreach groups

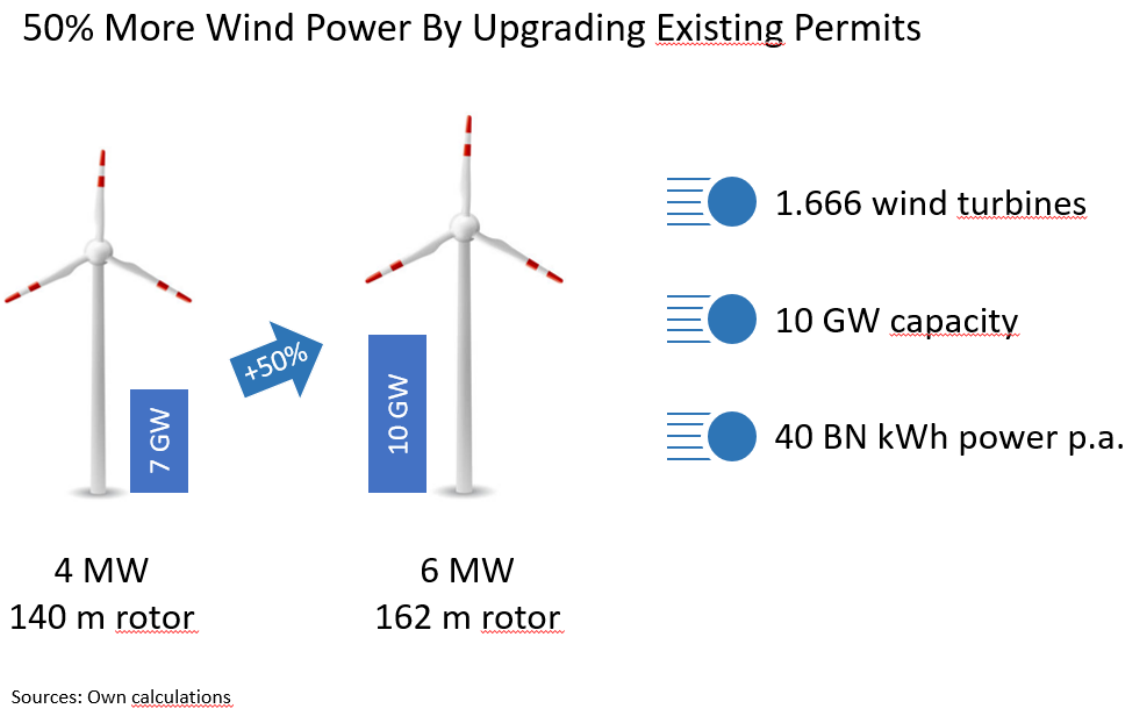
Measure 1 – Connect biogas plants to the gas grid / substitute 75-94 bn kWh gas

- The existing 10,000 biogas plants can be connected to the gas grid at short notice by approximately 50,000 HVAC companies

- **Accelerate connection**: Connecting biogas plants to the gas grid needs about 6 months according to industry experts. Technically, however, it is quite well possible to **accelerate** this timing to about **30-60 days** via a respective enactment (1 week planning, 1 week permission, 2-6 weeks building time).

- **Tools**: Connection premium with deadline July 1st 2022 / Connection obligation (define exceptions) / Decision to feed-in biogas or power by Federal Network Agency, **connection deadline** October 1st 2022, biogas plants can be steered **flexibly** short to medium term. This way, they can fill the gaps of a 100% renewable power production via solar and wind energy and **stabilize** the **power grids** in the rural area, as well as powering local **district heating networks** in winter. In the summer term, when no thermal heat is needed, they can primarily be used for **producing biogas** to fill the gas storages.

Measure 2a – Wind energy & heat pumps / substitute 100 bn kWh gas

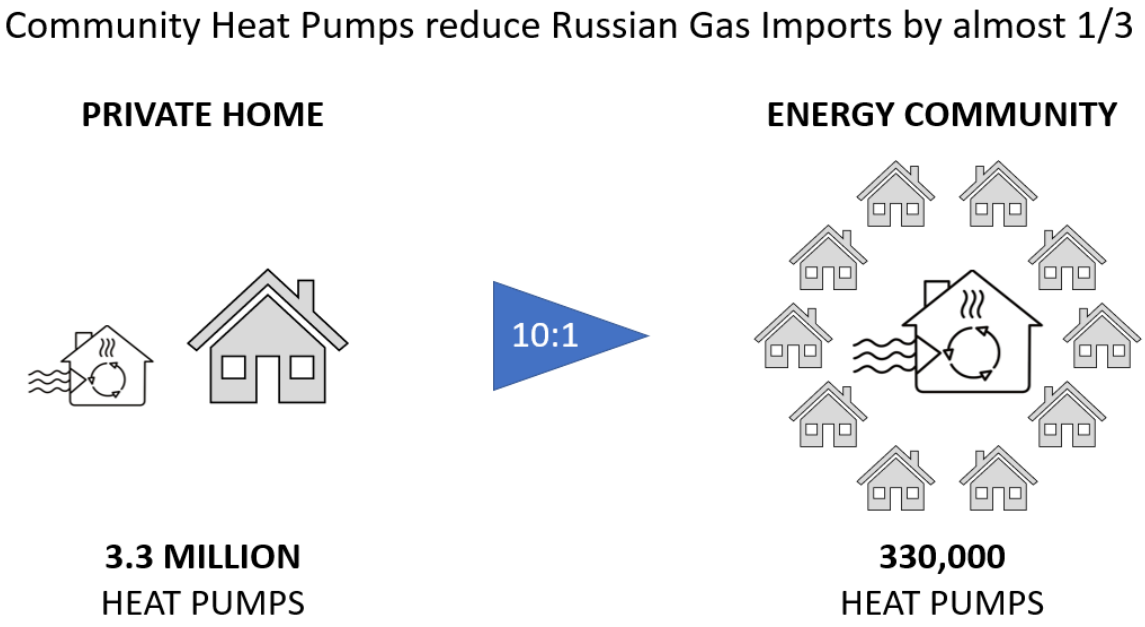


Sources: Own calculations

- This study identifies **50% more wind energy** for the winter term by enabling a **"type-open approval"** for the 2.000 wind turbines which are already permitted to construct. However, after years of permission proceedings, the current permissions only allow 3-4 MW wind turbines instead of actual 5-6 MW ones.

- This amounts to **40 bn kWh wind power**, sufficient for heat pumps for **3 million households**. Given a typical seasonal performance factor for heat pumps of 2.5, these substitute **100 bn kWh gas**, meaning $^{1}/_{3}$ of German gas imports from Russia.

Measure 2b – Energy sharing / neighborhood energy community



- **Factor 1:10** – Each heat pump can supply 10 households on average (1:10), thus requiring to install **330,000 heat pumps**. In 2021, 154,000 heat pumps have been installed in Germany, meaning half of the required amount (Bundesverband Wärmepumpen e.V., 2022).

- An essential supporting measure should be the regulatory enablement of **neighborhood energy communities**. This way, neighbors can share energy, and use shared heat pumps. The most simple case for this would be the neighborhood in an **apartment building**.

Energy Sharing

Technically
Power and heat grids can be professionally installed to connect households.

Legal
The existing legal framework often prevents respective neighborhood energy communities, whether for joint PV plants or joint heat pumps (“mini district heating grids”). Respective bureaucracy and legal frameworks need to be adapted.

Solution
Adding the following **clarification** in the **energy commerce law** (Energiewirtschaftsgesetz, EnWG) can provide a solution short term (Meyer Consulting, 2022): **“Using the generated and in a customer plant (in terms of the EnWG) consumed power is not classified as a power delivery”** (applies to all statutory rules). This, e.g., would allow to simply bill **landlord-to-tenant electricity** via the **service charge settlement**. Neighborhood **“mini district heating grids”** also should not require any permission and only be **due for notification**.

Measure 3a – Indoor insulation via a DIY store system / Substitute 100 bn kWh gas

- Indoor insulation can be installed via self-service based on a **DIY store system**. Experience from a respective system shows a saving potential of 70% of heating costs.

- The required knowledge can be achieved via a **10-minute online course** available in DIY stores, which can also be organized via qualified craftspersons.

Project week in schools
A nationwide obligatory **project week** in all **schools** could enable pupils, guided by qualified craftsmen, to **insulate their own classrooms**.

Energy independence week
The summer holidays qualify for a **voluntary "energy independence weeks"** to be organized across schools, universities and suchlike. Volunteers like pupils, apprentices and students can support other people to insulate their flats and buildings. They should be supported and the insulation be technically approved by qualified craftspersons.

5,000 € indoor insulation premium
A respective premium shall incentivize the indoor insulation. 50% of the premium shall be paid based on a simple digital registration of the flat or building. The other 50% shall be paid upon final technical approval by qualified craftspersons.

5,000 € energy independence premium
Each household which cuts its gas connection until December 31st 2022 shall get a one-time **energy independence premium**. The number of premiums provided is limited to 4.7 mn households (substitution of 100 bn kWh gas).

„All paid for"
Each participating households earns the right to receive a **100% loan** from the German investment and development bank (KfW) for financing a **heat pump** or **insulation** measures. The loan repayment will be designed such that the monthly credit rate will be lower than the respective heating cost savings. Thus, participating households will **benefit from day 1**.

Measure 3b – Indoor insulation with DIY store system / municipal implementation

Energy independence centers
Similar to the covid-19 test centers, schools, vocational schools and adult education centers can be used as energy independence centers during the summer holidays. They serve as center for organising the energy independence weeks, which may also be continued after the summer break in the adult educational centers.

These centers can serve 3 duties:

A) Information
Interested tenants and landlords can inform themselves on **energy independency opportunities** in their local school. The schools furthermore serve as demonstration project for indoor insulation.

B) Online course
Interested tenants and landlords, complemented by further volunteers, can participate within a 10-minute online course to get the basics on indoor insulation. Participation in this online course should be a precondition to be eligbile for the 5,000 € energy independence premium and the 5,000 € indoor insulation premium.

C) All-round carefree package – heating at ½ the price
Interested citizens can apply for a municipally organized, nationwide, uniform all-round carefree package.
Municipalities organize **volunteer teams** to support on indoor insulation. They furthermore provide the **total payment** of the measures via the premiums and via organizing KfW credits. Applicants receive a bonus of 250 € when applying for the all-round carefree package, as well as further 250 € upon technical approval of the measure. Furthermore, all required material and work – including self-service – can be paid from the indoor insulation premium.

Measure deadlines
Alle measures are limited until December 31st, 2022.

Energy independance premia are limited to 3.3 million households – first come, first serve.

Indoor insulation premia are limited to 4.7 million households – first come, first serve.

Measure 3c – Indoor insulation with DIY store system / practical advice

It is a simple measure to **insulate** ones own home **indoors**. A simple 10-minute DIY store video gives all information you need.
Whilst this does not work everywhere, e.g. on a tile wall in a kitchen or behind heavy cupboards, it works quite well on normal **exterior walls**, **floor ceilings** or the **basement ceiling**. Simply start with a simple DIY store system in three steps (timber scaffolding, insulation board with impervious foil, gypsum plasterboard).
Every single insulation board, even of a half-insulated exterior wall, reduces heating costs and gets you closer to energy independency. Is costs even less then continuing with business as usual. And saves lives.

Measure 3d – Indoor insulation with DIY store system / costs

The following pictures and data have been collected from a DIY store in Plettenberg, Sauerland, Germany in April 2022.
The following simple rule of three calculations can be adapted to actual values.

Insulation roll, 10 cm thickness, heat group 0.32	€ 59.99,-
per square meter	€ 10.20.-
Example	
Area living room	5m x 5m = 25m^2
With 4 walls, thereof 1 exterior wall	5m x 3m = 15m^2
(less windows)	15m^2 – 5m^2 = 10m^2
Timber scaffolding for insulation	€ 10,- per m^2
Timber scaffolding for 1 exterior wall	10m^2 x € 5,-/m^2 = € 100,-
Indoor insulation per m^2	€ 10.20,-
Indoor insulation wall living room	10m^2 x 10.20,- = € 102.00,-
Impervious foil	€ 5,- / m^2
Impervious foil for 1 exterior wall	€ 5,- / m^2 x 10 m^2 = € 50,-
Gypsum plasterboard + plaster	€ 10,- / m^2
Gypsum plasterboard + plaster for 1 exterior wall	€ 10,- / m^2 x 10 m^2 = € 100,-

Indoor insulation / living room
Timber scaffolding + indoor insulation + impervious foil + gypsum plasterboard
€ 100,- + € 102,- + € 50,- + € 100,- = € 352,-

The living room indoor insulation costs € 352 in DIY mode based on a simply DIY store system.
Energy independence volunteers can insulation the living room for a lump-sum.

Indoor insulation / 60 m² flat

- Living room € 352,-
- Room 1 € 352,-
- Room 2 € 352,-
- Kitchen and bathroom hardly doable as DIY
- Basement ceiling € 500,-
- Roof framework € 500,-
- Hallway, other € 500,-

Total costs	**€ 2,556,-**
Indoor insulation premium	€ 5,000,-
Available for DIY	**€** 5,000,- - € 2,556,- **= € 2,444,-**

The indoor insulation of a typical flat costs about € 2,556,-. Based on a € 5,000,- indoor insulation premium this leaves **€ 2,444,- for DIY efforts**.
Alternatively, this sum can be used to pay volunteers via a lump-sum fee.
Should higher costs apply, these can be financed to 100% via the German investment and development bank (KfW) www.kfw.de/beg

Measure 3e – Scaling indoor insulation to 4.8 million households

There are 10.9 million pupils in Germany
= Indoor insulation potential for ~ 350,000 classrooms

In September 2019, more than 1 million people have been joining the climate protests in the streets of Germany. Civil society is demanding change.
= Indoor insulation potential for 1 million households

If every climate protest participant ask two friends to join
= Indoor insulation potential for 2 million households

If every participant supports their parents or grandparents
= Additional indoor insulation potential for 1 million households

If every 10th pupil convinces their parents to join
= Indoor insulation potential for 1 million households

= so, in total this represents **5 million households** and 350,000 class rooms

From climate protests to a solutions movement
Politics has the opportunity to enable a true energy independence movement with the civil society and with ongoing **climate protests**. Such independence movement is really a new **climate solutions** movement.

Massiv heating costs savings
With the recommended „all-round carefree package – heating at ½ the price“ and via the recommended indoor insulation premium, the insulation measures can be implemented at no charge. This allows to save on heating costs, forever.

Climate solutions pay off. No excuses left.

Checklists for political action groups

CHECKLIST: TOP 3 Nat Gas Replacement

- ◯ **1) Biogas plants** connect to **pipelines**
- ◯ **2) Heat pumps** + **type-open wind turbines**
- ◯ **3) Indoor insulation** with home hardware DIY approach
  - ◯ **Project week** „Energy Independance" for all schools / Students can indoor insulate their own class room
  - ◯ **Action week** Students can teach their parents how they indoor insulated their own class room
  - ◯ **„All-paid-for-carefree"**
    (digital package „**heating at ½ the price**")
    for parents that want to indoor insulate their homes
  - ◯ **Energy Independance Centers** (schools, community colleges / similar to Covid 19 test centers)
    10min online-course „indoor insulation DIY"
    fill out application 5,000,- „indoor insulation premium"
    fill out application „all-paid-for-carefree" package + 250€ signing bonus
  - ◯ **Energy Independance Week** organized by municipality (like voluntary social year)
    For students, apprentices and volunteers, insulate your neighbor`s home or apartment -get a lumpsum bonus- paid for by the „indoor insulation premium"
  - ◯ **Indoor-Insulation-Premium** 5,000 €, limited quota for each municipality to hand out to 1st comes, 1st serves
  - ◯ **Proactive consultation** by municipality to hand out „All-paid-for-carefree" package „heating at ½ the price" (mandatory for municipalities until quota achieved)

CHECKLIST: Mobility + Heating

„Mobility“ – private actions

- ◯ Bike & E-Bike for inner city and short distance travel
- ◯ skip each 5th ride = 1 day per week car free
- ◯ Weekend tourism: Use bike and public transport
- ◯ Get an EV (if you need a car)
- ◯ Ride share = 1 day per week car free

„Heating“ - private actions

- ◯ Indoor insulation with DIY home hardware system
- ◯ 20 degrees Celsius room temperature = 2 degrees less
- ◯ Community heat pump
- ◯ Get off natural gas supply
- ◯ (temporarily) 18 degrees room temp = 4 degrees less

„skip each 5th ride“ – political actions

- ◯ BIKE: allow for temporary pop-up bike lanes
- ◯ Public transport: extend national 9€ ticket / Order
- ◯ Home-Office: right to / Order
- ◯ Ride Share: allow it / change transportation law

CHECKLIST: Renewable Energy Fasttrack (Outlook)

ABBREVIATIONS „Fast implementation of wind energy“

- ◯ **Typ-open** Permits = a change in turbine type is a non material change, as long as immissions stay the same (sound, shadow) / add sentence to §15 BIMSCHG
- ◯ **Zoning** 500m Autobahn stripes are privileged (zoned) for wind, and 200m for solar energy / add to §35 BauG
- ◯ **Realtime-monitoring** with automatic shutdown / risk free simulation mode in 1st year breeding season (= proof of concepts) / better for birds than yearlong studies („**win, win**“ for nature and climate) / Order
- ◯ **Clearinghouse** for permits / resolve legal grey areas with by independant third party based on state-of-the-art technology / resolve in 3 months / Verordnung

„Solar cell production in Germany“

- ✓ Solar cell production to become „Important Project of Common European Interest“ (**IPCEI**)
- ◯ **100% KfW loan program** w/ 90% guarantee for Gigawatt-Solar-Cell production

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