Version January 31, 2023
Tidied on March 21, 2024
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QUESTIONS OFTEN ASKED ABOUT THE ASSUMPTIONS UNDERLYING "TAX THE RICH"

NUMBERS NEED TO BE CHECKED FURTHER TO ENSURE CONSISTENCY. ALREADY CHECKED AGAINST FIGURES DATED DECEMBER 14, 2023 ("HOPEFULLY FINAL PLAN FOR ILLUSTRATIONS IN TTR")

Introduction

Germany has decided to cut greenhouse gas emissions to zero by 2045. This will require complete phase-out of all German use of coal, oil and gas fossil energy by 2045. Which in turn will require the building and successful operation of enough renewable energy (sun, wind, hydro and bio) to run the country without the use of (unabated) fossil fuels.
However, the upfront cost of renewable energy (e.g. the cost of building wind and solar farms) is so high that the profitability (using normal discount rates) on renewable projects is so low that subsidies (or direct investment in renewables by the government) are needed to accelerate the introduction of renewable capacity.
In our book *Tax the Rich*, we propose that these subsidies should be paid for by the richest 10%, since they already receive a disproportional share of national income, and only pay limited taxes. And because we doubt that it will be politically feasible to send the bill to the ordinary German citizen.

Language

1. We use the word "*green energy transition*" to describe the job Germany must complete over the next several decades in order to make Germany renewable by 2045. That is to build – and run – enough renewable capacity (sun, wind, hydro and bio) to replace all current use of coal, oil and gas. Plus, to build – and run – all the infrastructure (net, storage, electric vehicles, heat pumps, synthesizers, fuel cells) that will be needed to run Germany on renewable energy only.
2. We use the word "*renewable Germany scenario*" to describe the resulting time development from 2020 to 2045.
3. We use the word *"business-as-usual scenario"* to describe what we believe will be the future path of Germany if decision-making follows traditional patterns (that is, without forceful subsidies to new renewable capacity).
4. We use the word *"total energy use"* to describe the "use of electricity" plus the "use of heat" (defined as the direct use of fossil fuels for heating, transport, and other industrial use). We measure total energy use in tons of oil equivalent (toe). We convert non-fossil electricity use into tons of oil equivalent by multiplying with a fixed factor 4 TWh-el per million ton of oil equivalent.
5. We treat *nuclear energy* (largely electricity) as a separate category. We assume that there will be no use of domestic nuclear energy after 2023.
6. We use the word "*spending on energy*" to describe the total amount Germany spends on energy (in billion euros per year). This is the sum of CAPEX (investments in new energy capacity) and OPEX (operating costs of existing energy capacity, including cost of fuel).

7. We use the word "*x % of GDP*" to describe a) spending which amounts to x % of national income and b) the fraction of total productive capacity (total labour and capital) which is used in a given sector (for example the renewable sector.)

Central quantitative assumptions

(MUST BE ADJUSTED TO BE CONSISTENT WITH PUBLISHED ANALYSIS!)

Our analysis is based on a number of quantitative assumptions which we made in order to reflect the current German situation and increase the relevance of our qualitative thinking. These are the most important assumptions:

Data from Figure B Trends Germany 2000 to 2060 dated JR 9/12-23:

Germany's population will stay relatively constant to 2060 at around 83 million people (Mp) - in both scenarios. The workforce will also stay stable.

Germany's real GDP will grow slowly towards 2060 in the "business-as-usual scenario" (around 1 % per year), driven primarily by continuation of the historical rate of basic technological advance – linear at some 0,7 % per year in total factor productivity.

Germany's real GDP will grow even slower (around 0,7 % per year) in the "renewable Germany scenario".

Data from Box D JR 14/12-23, checked with Oekom Jan 24:

Germany's total energy use will stay relatively constant from 2020 to 2060 at around 333 million tons of oil equivalent per year (Mtoe/y).

Germany's total energy use in 2020 was split between electricity (133 Mtoe/y) and heat (200 Mtoe/y). In other words, the electricity fraction was 133/333=40 %.

Germany's total energy use in 2020 was split between fossil energy (268 Mtoe/y) and renewable energy (65 Mtoe/y). In other words, the renewable fraction was 65/333=20 %.

> Consequence: If all German fossil energy use (268 Mtoe/y) is to be replaced with renewable energy, Germany must build 268/25 = 11 Mtoe/y of new renewable capacity every year for 25 years.

In the "renewable Germany scenario" we assume that all fossil energy (both electricity and heat) is replaced with renewable electricity (from wind and solar farms) – with one half from wind and one half from solar.

> Consequence: To replace all fossil energy with renewable electricity by 2050 means adding 11 * 4 = 44 TWh-el/y of renewable generating capacity every year for 25 years.

Data from Box E JR 14/12-23

We assume that the cost of building new renewable generating capacity is 3 EUR/Wpeak-el, that the capacity operates at full utilization 2300 hours per year and lasts for 30 years. Which means a CAPEX of 3/(2300*30) = 0.04 EUR/kWh-el. We assume further that the operating cost of the new capacity is 0.025 EUR/kWh-el, and that the total cost of the necessary infrastructure (heat pumps, electric vehicles, batteries, hydrogen electrolyzers, fuels cells, distribution net and control systems) adds an extra 0.025 EUR/kWh-el. So total cost of renewables will be 0.09 EUR/kWh-el.

FURTHER DETAIL. TO APPENDIX!

Detailed calculation of the cost of renewable Germany:

This means building a lot of generating capacity towards 2050: x000 GWpeak-el wind power and y000 GWpeak-el of solar power (since we assume wind parks run for 3000 hours per year and last 25 years, while solar panels runs for 1000 hours per year and last for 40 years). We assume that the CAPEX for a wind park is ZZ! GEUR/GW-peak-el and ZZ2 for solar panels. This is a heroic average, since there are huge variation in cost (+-50%?) among individual projects depending on size, location and continuing technological advance.

Consequence: The accumulated building cost (CAPEX) of new renewable generating capacity will be 1.100 GEUR from 2025 to 2050, or 45 GEUR/y.

But Germany must also pay for the cost of operating the new generating capacity. We assume that the OPEX in 0.01 EUR/kWh-el for wind power and 0.001 EUR/kWh-el solar power.

Consequence: The OPEX will rise from 0 GEUR/y in 2025 to XYZÆØÅ 45 GEUR/y in 2050.

But in addition, Germany must build all the infrastructure which is necessary to use electricity to replace heat (and in an energy efficient manner). This means building enough heat pumps, electric vehicles, batteries, hydrogen electrolyzers, fuels cells, plus the distribution net and control system. We assume – again heroically – that this infrastructure costs the same as the new generating capacity.

Consequence: The necessary infrastructure will cost an additional 80 GEUR per year.

After 2050 Germany must start replacing old wind farms and solar farms when they reach end of useful lifetime. This means a continued CAPEX of some 71 GEUR/y. Plus a continued OPEX of existing capacity, which will also be some 80 GEUR/y. But Germany will no longer have to pay the high operating cost of fossil energy, some 0.09 EUR/kWh-el.

We assume that German greenhouse gas emissions (both CO2, CH4, and other gases) will decline gradually in the "business-as-usual scenario" to 50 % of current emissions in 2050, as fossil electricity production is phased out. Emissions drop faster in the "renewable Germany scenario" because fossil heat is also converted to renewable electricity – reducing emissions in 2050 to 15 % of current emissions (coming largely from agriculture).

Precision level.

The precision level in all our assumptions is low – typically +-10%. This also applies to our conclusions (see our paper on model reliability). Trends are more reliable than absolute values.

EUR denotes 2020-EUR.

Questions and answers

1. What will it cost to make Germany renewable (that is run by sun, wind, hydro and bio) by 2050? In other words, what must Germany spend on renewables and infrastructure year by year towards 2050?

Our answer: 70 billion EUR per year on average. Less in 2025, more in 2050. Importantly, Germany's spending on energy will be lower in 2050 than in 2020.

2. What must the German government pay (in the form of direct investment or as subsidies) in order to make Germany renewable by 2050?

Our answer: Up to 70 billion EUR per year on average. This amounts to some 2 % of national income and covers the cost of shifting 2 % of Germany's labour and capital from the rest of the economy into the renewable sector.

Importantly, the government may be able to reduce its cost through negotiation with the builder (for example through auctions) by receiving a fraction of the future income from the sales of the renewable energy. Thus, 2 % of GDP is an upper estimate.

FURTHER DETAIL – MOVE TO APPENDIX!

The spending on renewable will not occur by itself, because it is not profitable from the investor point of view. So, in order to happen at sufficient scale and pace, it must be paid for by the government – either directly, or indirectly in the form of subsidies to energy investors or energy consumers. The subsidies must be so big that the return to the investor

3. How much would German taxes increase if the transition to a renewable Germany were to be tax-financed?

Our answer: Gross taxes would increase from 38 to 40 % of GDP. Currently (2020) the German government collects 38 % of GDP in taxes (all taxes and fees, both direct and indirect). Spending another 2 % of GDP on the green transition would increase gross taxes to 40 % of GDP. That is not high compared to other rich countries.

4. How much would the income tax paid by the richest 10 % increase if they were to pay for the transition to a renewable Germany?

Our answer: The taxes paid by the richest 10 % would increase from 5 to 7 % of GDP. Currently (2020) the income of Germany's richest 10 % amounts to 37 % of GDP. Of which they pay 5 % of GDP in net taxes – that is a net tax rate of 5/37 = 14 % on income. This would increase to 5 + 2 = 7 % of GDP – or a net tax rate of 7/37 = 19% on income. This is a big increase, but the final tax rate of 19% of income is well below what most Germans pay.

5. What wealth tax would the wealthiest 1 % have to pay if they were to pay for the transition to a renewable Germany?

Our answer: The wealthiest 1 % of German households own more ca 90 % of all German wealth, worth some 9.000 billion euros. Thus, a tax of 1 % per year on wealth would cover the full cost of the green energy transition. Some rich countries, including Switzerland, has wealth tax rates at this level.

6. How much will total investment decline if Germany makes Germany renewable by 2050? In other words, how much slower will the German economy (GDP) grow if the rich must pay 90 billion euros per year (= 2% of GDP) extra in taxes?

Our answer: Total investment will change little, since much of the tax revenue will be used for investment. Only the composition of investment will change, from investment in all other sectors to investment in renewable energy and infrastructure. In the longer run this will lead to reduced output of all other goods and services, and the use of more capacity to produce the necessary energy.

FURTHER DETAIL – MOVE TO APPENDIX!
Owner disposable income will decline by 2 % of GDP – from 33 to 31 % of GDP. That is a decline of 2/33 = 7 %. We assume that owners maintain the traditional split between owner consumption, investment in productive capacity, and investment in financial assets. So all decline by the same 7 %. Thus, owners' investment in all other sectors will decline by 7 % (from 15 to 0,93*15 = 14 % of GDP). But at the same time government investment in renewables increase by 45 billion euro per year, that is 1 % of GDP.

9. How much will real consumption decline if Germany makes Germany renewable by 2050?

Our answer: Spending an additional 2 % of GDP on renewable energy (instead of spending it on all other goods and services) will lead to a one-off reduction in real consumption (of up to 2 %) because of higher energy prices. It will also lead to a similar reduction in real capital formation and government real revenues in real terms. Which in turn will lead to a decline in the growth rate of GDP.

10. What is the best way to increase gross government revenue by 2 % of GDP?

Our answer: We suggest a combination of i) a 1 % wealth tax on the wealthiest 1 %, and b) an increase in the corporate income tax from 3 to 4 % of GDP. The first must

be done in a way that reduces the flight of capital and owners to tax havens. The second must be done in an internationally coordinated manner that reduces the flight of companies and owners to other rich countries with lower tax rates. New legislation that forbids tax refugees from moving back to Germany without paying all the taxes that fell due in the interim, is a possibility.

But such tax increase will be politically difficult, if not impossible. Another, more innovative, approach would be to alter the central bank legislation and allow the central bank to increase the government budget by 2 % of GDP, strictly earmarked for (domestic) government spending on (unprofitable) renewable capacity and infrastructure.

11. What will be the effect on the wellbeing of the German majority of a green energy transition by 2050?

Our answer: It will increase the average wellbeing if equal weights are placed on increased disposable income, increased government spending, reduced emissions, reduced inequality, and reduced social tension.

APPENDIX

Annual spending of some 90 bill euros in renewable capacity

We believe it will take an annual investment of 90 billion euros per year in renewable energy and infrastructure in order to phase out all use of fossil fuels in Germany from 2020 to 2045.

The transition to a renewable Germany by 2050 will require (an average) spending on renewable capacity and infrastructure of 80 bill EUR every year from 2025 to 2050, rising to a maximum of 150 bill EUR in 2045. But the total spending on energy will not increase that much, because Germany will save a lot from not having to spend on fossil fuels (gas and coal) when fossil capacity is closed down to zero by 2045.

Making Germany renewable will cut German greenhouse gas emissions by 80%

This will cut to zero all greenhouse gas emissions from the use of coal oil and gas in Germany – which is roughly 80 % of all German greenhouse gas emissions.

Increased spending on renewable energy amounts to some 2 % of GDP

90 bill euro per year amounts to 2 % of Germany's GDP if calculated as average spending over the period. The total spending on energy will vary over time (first rise and then level off). Compared to (slowly rising) real GDP total spending on energy will eventually decline

Germany's energy bill will first be more expensive and then cheaper than today.

Total spending on energy will first rise to a peak (in 2035) and then decline to a level (in 2045) some 10 % lower than current spending on energy. Here is the detail:

Total spending on energy is the sum of CAPEX (investment in new energy capacity) and OPEX (the cost of operating the energy capacity).

Over the next 30 years we expect very little investment in new fossil (or nuclear) capacity, so future CAPEX will be dominated by investment in renewable energy and infrastructure (net, storage, electric vehicles, heat pumps, synthesizers, fuel cells) needed to run Germany on renewable energy only.

Over the next 30 years existing fossil energy capacity will gradually be closed down (as more renewable energy becomes available). The OPEX of the remaining fossil capacity (mainly the

cost of gas and coal – currently high 0.5 – 1 EUR/MWh-electricity) will decline in pace with fossil capacity.
The OPEX of the renewable capacity will rise in parallel with installed renewable capacity, but the OPEX is much smaller 0.01 EUR/MWh-electricity)

Constant energy use towards 2050.
We believe that Germany's population and total use of energy (sum of electricity and heat) will stay relatively constant towards 2050. Real GDP will grow slowly.