University of Basel

Exploring Possible Futures

Video Transcript

Social costs and welfare

In most of our modelling work so far, we've asked you to build a world according to a single objective, supply electricity at the lowest possible cost, or design an energy future with as little emissions as possible. However, life is rarely that simple. In real life, we face tradeoffs. If I'm thirsty, I can get a glass of water. This is usually cheap and effective. Or I could go for a fancy drink, which is much tastier, but it is expensive so that I can spend less on other things. In energy systems, we face much more complex tradeoffs. We could have an energy future where energy is cheap and abundant. As energy is cheap, we have much left to spend on other things.

However, this world is polluted, and we might face serious dangers from climate change. Another future is much cleaner. We have renewables that do not cause air pollution or contribute to climate change. It is great to live here, but it is costly. Energy is expensive, and thus, we have to be careful in using it. The question is how to decide between these futures. Most people do this without much reflection. We simply know when we pay for a fancy drink or content ourselves with water. But when we design energy futures that involve billions in investments, we need somewhat more elaborate tools.

There are two main ways of handling tradeoffs in energy and environmental economic models using social costs or social welfare as an objective. Both have in common that they reduce our tradeoffs where we have multiple objectives like costs and emissions to a single objective. This is necessary if we want to be able to make decisions in situations with major tradeoffs. We always have to find a way of combining multiple objectives to a single objective. If we use social cost to this end, we give each of our objectives something like a prize and add them up to total cost.

As these costs are usually the costs of a system seen from the societal point of view not from a single firm or consumer perspective, we refer to them as social costs. In case of modelling an energy future, we have different effects that induce costs. There are the investment costs and the variable costs of operating our power plants. There are emissions that cause costs. And there is a risk of nuclear accidents, which is also a cost component. To calculate social costs, we put weights on these items. For instance, emissions of greenhouse gases contribute to climate change, thus we put a price on every tonne of these emissions that equals what we call the social costs of carbon.

These social costs of carbon are simply the present value of future damages due to climate change that are caused by an additional tonne of emissions. To measure the risk of nuclear accidents, we could use a similar measure, the social costs of nuclear energy. This indicator measures the costs of different possible accidents weighted by the probability and relates them to the installed capacity. Once we have values for these items, we can minimise the social costs of meeting a given demand. As we have accounted for emissions and the risk of nuclear energy, this approach balances our trade offs in our decision problem in the best possible way.

In contrast, if we use welfare as a tool to handle tradeoffs, we measure the benefit that's a production of electricity causes, which depends on the total production. From this benefit, we subtract all the terms used in the social cost approach above. This approach is most useful if we consider different levels of total production. Thus, we would maximise welfare with regard to total production and with regard to the investment in and deployment of the different technologies. As we have fixed demand in our example, we use a social cost approach. It is important to note that neither the social costs of carbon nor the social costs of nuclear can be measured objectively.

For example, if we calculate the social costs of carbon, we have different generations that are affected by climate change and have to decide how much we value a generation living in 500 years compared to ourselves. Do they have the same importance, somewhat less importance, or do we discount their welfare strongly? This is an ethical decision, which cannot be made on the basis of measurements and data. Similarly, we have to ask how to handle the risk of nuclear accidents. We could either calculate an expected value based on probabilities or could account for the fact that many people are risk averse and thus give more weight to disastrous but rare accidents than probabilities would imply.

For this reason, we ask you in the next step to choose social costs of carbon and social costs of nuclear. The model will then automatically calculate the future energy system that minimises the social costs based on these two weights that you have chosen. Note that this is a much more complex mathematical model than the ones before. Up to now, you had to do the hard work of making investment and deployment decisions. Now, you simply set the criteria for making these choices, and the model does the hard work. When you use the model, try to understand what happens for different settings. Let us discuss your interpretation of the model results.

After this, we will show you how the model works in detail.