

FAQs for Wynes & Nicholas 2017

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Thank you for your interest in our study, “The Climate Mitigation Gap”. We’ve created this resource in response to common questions we’ve received. For more details, please see the [original study](#), published open access in Environmental Research Letters, and the accompanying data supplement.

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1 What's this study all about?

1.1. What inspired this research?

Many individuals are concerned about climate change and want to know which of their personal choices make the biggest difference for the climate. This includes many parents who want to pass on a better, safer world to their children, and are highly motivated to be part of working to reduce climate pollution as fast as humanly possible.

Seth was a high school teacher in Canada and his students were concerned about climate change and wanted to know what they could do about it. He wanted to be able to give them a science-based answer that could inform their decisions now and in the future.

We hope this information sparks discussion and empowers individuals who want to know what personal decisions they can make to make a real difference for the climate.

1.2 What did your study find?

We found four personal choices that consistently allowed individuals to substantially contribute to reducing climate pollution and make a big difference for the climate across

conditions found today in developed countries: eating a plant-based diet, avoiding air travel, living car free and choosing to have smaller families.

We found that these four choices were more effective at reducing individual greenhouse gas emissions than strategies commonly mentioned in government recommendations on climate change in the US, Canada, Australia, and the EU, and high school science textbooks from Canada.

1.3 Why focus this study on developed nations?

Finding ways for those in developed nations to lead a long, healthy, good life without producing such high emissions will be key to ensuring a good life for everyone.

Half of all the emissions in the atmosphere since the industrial revolution are from North America and Europe. [The other half is shared among China, India and 150 other countries.](#)

Currently, [nearly half of emissions are produced by 10% of the global population, with very high rates of consumption.](#)

1.4 Why focus on personal efforts to combat climate change, compared to efforts made by nations, companies, cities, or others?

Many individuals want to know what they personally can do to contribute to reducing climate pollution. Individuals who want to step forward on climate need to know how their actions can have the greatest possible impact. This research is about helping people make more informed choices.

Climate change is a problem for everyone on Earth. Basically, [the science tells us](#) that the future of a good life on Planet Earth depends on reducing climate pollution by about 90% by 2050.

Tackling climate change effectively depends on everyone- businesses, cities, national governments, civil society and more.

There is a lot of positive momentum on climate action from countries, local governments and cities, businesses, universities, and civil society organizations. For example, Copenhagen has committed to be fossil-fuel free by 2030, [and hundreds of US cities have committed to 100% clean energy by 2035.](#)

The greenhouse gases in the atmosphere today are the result of the aggregation of billions of individual decisions. So individuals are an important part of the solution. Many individuals (particularly those with resources in the developed world) can make choices overnight to change their behavior- for example, to stop eating beef or to fly less. This is a much faster impact than changing energy systems.

To limit the risks of dangerous climate change, per capita emissions need to be cut to about [2.1tCO₂e per capita by 2050](#), while maintaining a good quality of life in the developed world, and increasing opportunities in the developing world. That's about a 90% emission reduction for many individuals in North America, Australia, and Europe. Some of those pollution cuts will come from government policies like increased use of renewable energy, but personal efforts can also help.

The choices we make today make a critical difference for the climate. The best time to act to reduce emissions would have been decades ago, but the next best time is now. With climate change, the sooner we make adjustments to reduce emissions, the more options we have and the better off our planet will be in the future.

1.5 Which of the results of the study do you find most surprising?

Most surprising to us was that there was such a strong focus in high school textbooks on energy efficiency and recycling. These are positive steps to take and can save money and conserve natural resources. But there was almost no mention (4% of the statements given) of actions like eating a plant-based diet that would have much higher impact on reducing greenhouse gas emissions.

2. How were the numbers calculated?

2.1 How did you approach this study overall?

This was a “**study of studies**,” where we analyzed existing data from 39 sources, primarily peer-reviewed articles (to analyze the impact of diet, personal vehicles, and having a child), as well as carbon calculators and government sources (necessary for green energy and aviation).

To meet our criteria for inclusion, the sources had to be representative of current or the most recent available conditions in developed countries (i.e., no additional policy), and represent the results on an individual basis for one year. (We used country-specific data where needed to make these calculations apply to individuals, such as average vehicle and household

occupancy). For calculations, all actions were framed in such a way that they would take the maximum possible effect. For instance, eating a plant-based diet is framed as avoiding all meat for a year.

2.2 How confident are you in these results?

There are many factors that affect the climate impact of personal choices, but bringing all these existing sources side-by-side gives us confidence we've identified actions that make a big difference.

Some choices have been studied more than others, which means that their estimations are likely more precise. For example, we analyzed 13 studies that compared the impacts of going car-free vs. a typical gasoline car (see Supplement).

We provide mean values for our recommended actions, but we do not suggest that these are firm figures universally representative of each action, but instead best estimates. For instance, a transatlantic flight will differ in emissions magnitude based on the exact distance travelled, weight of a passenger's luggage, the occupancy of the plane, wind speed and many other variables, in addition to the differences inherent in varying assessment methodologies.

Our estimations are probably most useful when they compare different classes of actions (e.g., low vs. high impact) that vary substantially. We expect that further research will refine the methodologies used and improve the precision of the estimates we made here, but we find it highly unlikely that a high impact action would shift to low impact in another analysis.

2.3 In brief, how did you calculate the four high-impact choices?

Plant-based diet: The effect of a plant-based diet is calculated based on an average switch from an omnivorous diet to one that is either vegan (eating no animal products) or vegetarian (ovo-lacto vegetarian). Includes emissions from fertilizers, methane production by livestock and transport of food to retail centers.

One transatlantic flight: Emissions for one person flying on a roundtrip flight (e.g., New York to London) under average conditions. Note that long-haul flights are more (e.g., flying London to Hong Kong round trip is 2.97 tonnes).

Live car-free: Emissions saved per person based on average vehicle miles traveled and vehicle occupancy. Includes emissions from car production and maintenance in addition to combustion of fuel.

One fewer child: Estimates the cumulative impact of current and future descendants based on percent of relatedness for the offspring, and current emissions levels, for all emissions produced over the lifespan of descendants, divided by the life expectancy of each parent.

2.4 Is this the best way to estimate the carbon impact of choosing to have a child?

This is a very difficult question to answer. In our research, we were only able to find one peer-reviewed study that met our criteria for inclusion (see above) regarding the carbon impact of having a child in developed countries, assuming a continuation of current trends and consumption levels.

Other studies might make different assumptions about lifespans, emissions levels given changing technology and consumption patterns in the future, allocation of emissions over time, and so on, which would change the exact estimate for how big of a carbon impact having a child would be.

We would welcome more published studies in the peer-reviewed scientific literature that try to explore this question in more detail.

2.5 In more detail, how were the reduction of emissions of choosing to have one child less calculated?

For this choice we relied on the research done by [Murtaugh and Schlax](#). In their system, a parent considering the effects of having an additional child is responsible for emissions according to the fraction of their genes that they pass on (i.e. each parent is responsible for 1/2 of their children's emissions, 1/4 of their grandchildren's emissions and 1/8 of their great grandchildren's emissions, and so on for many generations). They used average birth rates and life expectancies to show how many children one new child is likely to have in a certain country (and how many offspring those children would have and so on). All the emissions from these descendants were divided over the life expectancy of each parent (80 for the case of a female in the United States). Their paper has some useful diagrams that explain the method.

2.6 Would the climate impact of having a child always be so high if society reduced emissions?

Murtaugh and Schlax used different scenarios for how much greenhouse gases society would produce in the future to model the carbon legacy of having one additional child. Here we've reported the results for historical emissions, what could be considered as constant emissions.

In their scenario where emissions are greatly reduced (by 85% in 2100, compared to 2000), the climate impact of having a child is also greatly reduced (up to 17 times smaller). See the study by [Murtaugh and Schlax](#) for more details.

2.7 I expected eating a plant-based diet to save more greenhouse gases?

Eating a plant-based diet is a very effective way to reduce a person's greenhouse gas emissions, and one of the largest contributions an individual can make for the climate. But there are also qualitative reasons why it is an effective choice for the environment. As we point out in our paper, it reduces demand for water and other resources like fertilizer, and the fact that it requires less land means there can be more space for other species. The climate savings of the switch from an omnivorous to a plant-based diet also depends a lot on how much meat the person making that switch was eating in the first place.

Although this was not a research question that we tried to answer, we found that vegan diets tended to be more effective than vegetarian diets at reducing greenhouse gas emissions (see Supplement).

3. What about other personal actions to reduce climate impact?

3.1 Why don't you focus more on green energy or solar panels?

In many regions we found evidence that purchasing green energy was a positive, substantial action. But that can vary even within a country. Furthermore, some [researchers have reported issues with "double counting" of green energy](#) in some parts of Europe. That makes it difficult to quantify exactly how effective these actions are at an individual level. However, existing research suggests that buying green energy from the grid was a high-impact action in Canada, Australia and the US (Figure 1 of our study). More research would be helpful in

understanding the exact conditions where consumers purchasing green energy is most effective. Identifying the regions where this action is most effective and where there is no double-counting would take a whole other study.

Solar panels fall into a similar category. In certain areas they are likely to be very effective at reducing greenhouse gas emissions. But quantifying that depends on the size and type of photovoltaic as well as the region it is being installed. We focused on personal choices that were effective throughout the developed world.

3.2 Why does changing a typical gasoline car for an electric car have only a moderate effect?

Electric vehicles are a step in the right direction. One of the reasons they are only moderately effective at reducing greenhouse gas emissions at this point is because the electricity needed to charge them is currently produced mostly by burning fossil fuels. Greater emissions savings are possible from electric cars as energy grids get cleaner. But electric cars are still cars- they're associated with environmental toxins, and they still require parking lots and highways. Living car-free can also reduce obesity (in fact, [each hour spent in a car per day is associated with a 6% increase in the likelihood of obesity](#)).

3.3 Why are lower-impact actions, like recycling, not sufficient to tackle climate change?

All of the low-impact actions are good things to do. They can have benefits for saving money and reducing pollution. But they are more of a beginning than an end as solutions for climate change. They are certainly not sufficient on their own to tackle the scale of the climate challenge that we face.

Recycling is a positive action that conserves natural resources and reduces greenhouse gas emissions. But some people have been recycling for years and they are ready to take bigger steps. Choices like eating a plant-based diet can be four times more effective at reducing an individual's greenhouse gas emissions than recycling.

3.4 If we accumulate all actions of low and moderate impact, does that equal the effect of any of the four major actions?

Certainly adding up many small or moderate actions could equal one of the four major actions. If all done together, hang drying laundry, comprehensive recycling, washing clothes

only in cold water and upgrading a household to more efficient light bulbs would save money, energy, and natural resources, and add up to about 0.77 tonnes of greenhouse gases reduced. That's quite close to 0.8 tonnes reduced for eating a plant-based diet. But even so, there are other reasons that eating a plant-based diet is helpful (it conserves biodiversity because it requires less land, more people can be fed from the same land, and it's good for health).

4. What about other actions you didn't include?

4.1 What about the climate impact of owning a dog?

We found only two studies measuring the carbon footprint of dog food, which we suspect would be the largest fraction of emissions that could be attributed to dog ownership. However the studies gave very different estimates for the size of that impact (see the Supplement to our paper). We can suggest that because smaller dogs eat less food, they likely have a smaller carbon footprint.

4.2 How important is generally reducing consumption - things like cellphones and clothing?

We found "reduced consumption" to be very difficult to frame as a concrete choice. Can someone adopting the action of "consuming less" still own a smartphone? Or buy "x" number of new clothing items per year? Certainly products like [cotton clothing and electronics can contribute to an individual's greenhouse gas emissions](#), but the intensity of these action also moderated by how long a consumer uses them and whether they recycle them at end of life.

Consuming less is a positive step for the climate and the environment in general, but we found that the fuzzy boundaries of defining this make it difficult to quantify and generalize in a way that we could meet the criteria to include in this study. We would welcome more research in this area.

5. What can I do as an individual?

5.1 How can an individual use this information to inform their personal decisions?

Recognizing that our diets and how we move around are the biggest daily levers on our climate impact we have as individuals is an important step. We have heard from many members of the public that they are already taking some of these high-impact actions, or are considering going further now that they know these choices really count for the climate.

A new mother in Sweden wrote:

“We became parents 3 weeks ago and we are trying our best to cut down on our carbon emissions. Thank you for the graphics. I'll put them on our refrigerator so I'll make sure we're reminded every day.”

We have also heard from individuals who are looking for ways to implement some of these high-impact actions in schools, workplaces, and communities- for example, making tasty plant-rich foods the norm in cafeterias, or changing workplace travel policies to support teleconferencing or slower travel.

For individuals currently considering having a child, recognizing that family size affects the climate can be one of many factors informing a complex and highly personal decision.

6. What about my region?

6.1 Do the results for developed countries differ greatly from developing country's realities?

The scope of our research is limited to developed countries because those tend to be the nations with higher per capita emissions and the greatest opportunities for individual choices to reduce individual emissions while maintaining a high quality of life.

Also, there were very few studies available quantifying the climate impact of these type of individual choices for developing countries (shown in grey in Supplementary Table 4 of the paper). This is probably because many of these choices are not as relevant for developing

countries, and because the per-capita emissions of developing countries tends to be much smaller than for developed countries.

6.2 Are there differences among developed countries in the impact of these choices?

The impact of certain actions can be quite different between nations. For instance, driving an electric vehicle in a region where electricity is mostly supplied by renewable energy can be a big step forward compared to driving an internal combustion vehicle. But if the electricity that charges the electric vehicle is generated from coal power, then an electric vehicle may be no better at all. Figure 1 in [our paper](#) shows some regional differences. The four big choices we focused on were consistently high-impact across regions.

7. What's next?

7.1 What reactions do you expect from this study being published?

We hope this information sparks discussion and empowers individuals who want to know what personal decisions they can act on to make a real difference for the climate.

A lot of people are worried about the serious risks from unchecked climate change and want to know what they can personally do to be part of the growing momentum towards solutions. In a recent survey in Sweden, [92% said it was important to live climate smart, but only 13% said they knew what to do to live climate smart.](#)

One thing that's important to realize is that currently [nearly half of emissions are produced by 10% of individuals, mostly in developed countries, with very high rates of consumption.](#) I think many people are unaware of how unusually high their emissions are, and how it's possible to have a really good life with much less climate pollution.

7.2 Should school books be updated when it comes to the topic of fighting climate change on an individual level?

Current recommendations tend to give a laundry list of possible actions, with no information on which ones might be more effective, and therefore which to prioritize. Providing numbers or rankings, or at least discussing relative climate impact (high, medium, low) of different actions, is important information to guide individual choices.

For example, one climate action recommended in a high school science textbook in Canada was switching from plastic to canvas bags. This is a good step to conserve resources and reduce plastic pollution in the oceans, but this is less than 1% as effective for the climate as a year without consuming meat. Examples like this create the impression that the issue of climate change will be solved with minor actions.

7.3 Are government recommendations and textbooks promoting the wrong initiatives?

We analyzed recommendations from 4 governments in developed countries for what individuals can do to reduce their greenhouse gas emissions. What we found is that they tended to focus on medium or lower impact actions, like recycling, using canvas bags, or conserving water. These actions help, but many people are doing them already, and they aren't sufficient for the scale of the climate challenge. For example, eating a plant-based diet is 4x more effective for the climate than recycling, and 100x more effective than using a cloth bag.

8. How do you as authors see this research?

8.1 How have the authors taken up these choices?

Seth: I've personally enjoyed a more leisurely pace on a few trips by taking the train, getting work done with the train's wifi, and avoiding the hassle of security at the airport. I've never owned a car, and I do my best to eat a plant-based diet, although I will eat meat if it's about to be thrown out because I like to prevent food waste as well.

Kim: I've written [an essay](#) about this for Scientific American, but in brief: I've cut my flying 80%, sold both my cars and moved to the center of my small city where I can bike to work, and gone meat-free. All of these choices have enhanced my quality of life.

8.2 Is this all about sacrifice?

This research is not a sacrifice message. It is trying to find ways to live a good life and at the same time leave a good atmosphere for the planet. Many of the choices actually have positive effects on individuals' lives, such as a healthier diet, as meat consumption in developed countries is currently many times higher than recommended by health authorities. Cleaner transport also cuts air pollution, and walking and cycling can lead to reduced obesity.

8.3 How is this research relevant for young people?

Adolescents are concerned about the planet that they're inheriting and they're interested in finding out how they can be part of climate solutions. They will soon be making life choices that could have important impacts on the climate for the rest of their lives. For example, young people might plan to prioritize living close to work or school so that they don't need to rely on a car.

8.4 What do you personally think about the carbon implications of the choice to have a child?

Parents have a huge reason to care about the future for their kids. Having a child is an enormous decision in every respect- personally, professionally, financially. Our research shows it is also by far the biggest choice we make in terms of the climate. Put simply, in countries with high emissions rates, adding more people adds a lot more carbon to the atmosphere- and their children will add more still.

Young people are also some of the most vulnerable to climate change. A child born today in one of these developed countries has a good chance of living to see the year 2100, by which time there will be an enormous difference in the world depending on whether business as usual is followed, or a big commitment to serious emissions reductions is undertaken. Many parents are concerned about the world their children are inheriting and are prepared to step forward in their personal actions in order to help protect their children.

What this says to me is that, if kids today grow up at the same high emissions rates as their parents, they will be inheriting a world of dangerous climate change. Enabling kids to grow up in a safe climate is a huge motivator to reduce overall national emissions to sustainable levels, and has [motivated some parents](#) to reduce their household emissions as well.

Meanwhile, recognizing that family size affects the climate can be one factor informing a complex and highly personal decision.

For individuals who want to have a child knowing the risks of unchecked climate change, I see it as a vote of hope that the world is going to be a better place and we can actually tackle this challenge- and a huge motivation to be part of working to reduce climate pollution as fast as humanly possible.