

## Beyond Carbon: The nitrogen footprint is a new tool for sustainability

### What is a nitrogen footprint?

**Y**ou have probably heard of the carbon footprint, but have you heard about the nitrogen footprint?

A nitrogen footprint is a new tool that connects our consumption patterns with the associated nitrogen pollution released to the environment. Nitrogen pollution contributes to a series of negative impacts on human and ecosystem health, including smog, acid rain, biodiversity loss, dead zones, and climate change. However nitrogen is also a nutrient: all species on earth need nitrogen in some form to survive, and we consume our nitrogen as protein. We must therefore figure out how to optimize the use of nitrogen while minimizing its negative consequences. The nitrogen footprint is a tool that can help address this challenge by communicating how our consumption patterns are impacting the environment.

A nitrogen footprint is defined as the total amount of reactive nitrogen (all types of nitrogen except the unreactive  $N_2$  that makes up most of our atmosphere) released to the environment as a result of resource consumption (Figure 1). The two main pathways through which we release nitrogen pollution to the environment are fossil fuel combustion and food production. When a fossil fuel is burned, reactive nitrogen is emitted to the atmosphere as a waste product. The use of nitrogen in food production, on the other hand, is intentional. Nitrogen is a key nutrient for food production and is contained in fertilizers. However, most of the



nitrogen used in the food production process is lost to the environment, where it damages ecosystem and human health.

There are two parts to a food nitrogen footprint: the food consumption and food production nitrogen footprints. The food consumption footprint is simply the amount of reactive nitrogen contained in the food that actually enters the human mouth. Because the average adult does not typically accumulate nitrogen, this reactive nitrogen will enter the sewage stream and—unless it is converted to  $N_2$  by treatment—ultimately the environment. The food production nitrogen footprint varies by food type (Figure 2). The food production footprint includes losses at each stage of the food production process, including fertilizer runoff, manure losses, and food waste. On average, livestock products typically have a larger nitrogen footprint than crops because there are additional steps to the food production process. Stated another way, less nitrogen used in food production makes it into the final food product.

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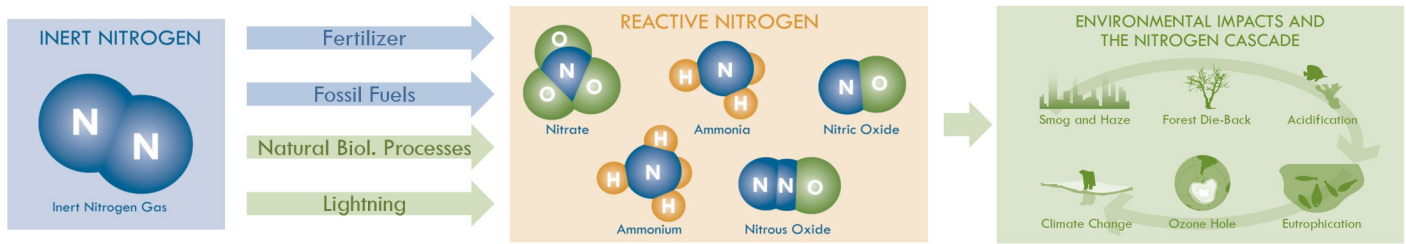


FIGURE 1. The conversion of inert nitrogen ( $N_2$ ) to reactive nitrogen species and several of the potential environmental impacts resulting from excess reactive nitrogen in the environment.<sup>2</sup>

## Nitrogen footprint tools for individuals and institutions

A tool is available online to calculate your personal nitrogen footprint ([www.N-Print.org](http://www.N-Print.org)). These nitrogen footprint tools are country-specific, and they are currently available for the United States, United Kingdom, Netherlands, Germany, Austria, and Japan. Tools are in development for Denmark, Australia, and China. The tool asks questions about your weekly food consumption, your utility usage at home, and how far you travel each week. You can then use the tool to see how changing your personal consumption patterns will impact your nitrogen footprint.

The nitrogen footprint concept is now being applied at universities. The first institution-level nitrogen footprint calculation was completed at the University of Virginia (Figure 3). This tool has since been updated and expanded for use by a broader range of universities. A group of institutions—including the University of New Hampshire—is now testing the tool before it is launched publicly. The calculation of the baseline nitrogen footprint for the University of New Hampshire will be complete in fall 2015.

### How can you reduce your nitrogen footprint?

Our everyday choices—from how we travel to work to what we eat for lunch—impact our personal nitrogen footprint. There are many easy steps we can each take to reduce our impact on the environment.

Any time you reduce your energy consumption or lower your carbon footprint, you will also reduce your nitrogen footprint. You can choose public transit over driving, reduce your electricity usage, and recycle.

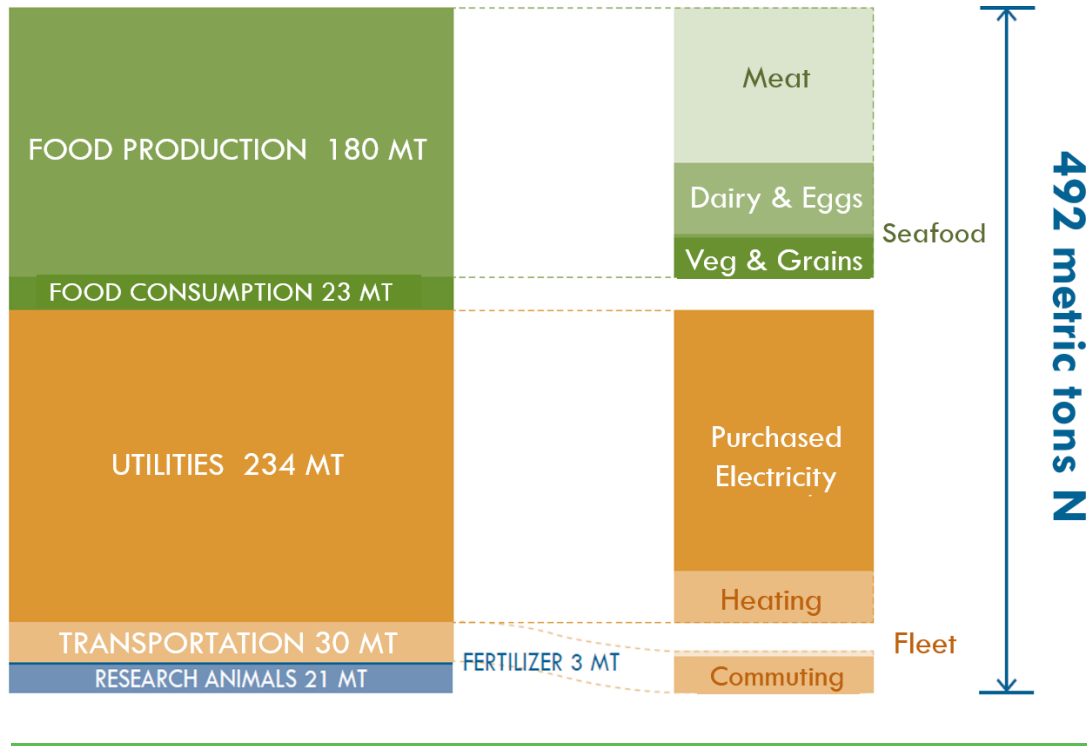
On the food side, we have a greater potential for reduction since food typically makes up the majority (over 70%) of a personal nitrogen footprint. The following are some choices you can make to reduce your food nitrogen footprint:

- *Consume the recommended amount of protein.* The average person in the US overconsumes protein, which can lead to health concerns as well as a larger nitrogen footprint.
- *Choose both vegetable and animal protein sources.* Meat and animal products make up about 75% of the average person's food nitrogen footprint due to higher rates of consumption and food production losses. Vegetable protein sources have a lower environmental impact and promote good health.



FIGURE 2. The food consumption and food production nitrogen footprints for a 3 oz steak and 1/2 cup of beans. The food consumption nitrogen footprints are identical, but the food production nitrogen footprint of the beef product is substantially larger than that of the beans.

- *Reduce your food waste.* In the US, over 30% of food is wasted along the food chain. You can reduce your personal food waste by only buying what you need and being sure to eat leftovers.



**FIGURE 3.** The nitrogen footprint of the University of Virginia in 2010. The first institution-level nitrogen footprint calculation was completed at the University of Virginia, and other universities are now testing the tool.<sup>1,2</sup>

### Combining the campus carbon and nitrogen footprints

The nitrogen footprint has significant overlap with the carbon footprint, particularly in the energy sector. In addition, most carbon footprint reduction strategies will also reduce the nitrogen footprint, which is a win-win for sustainability. Ultimately, we aim to combine the campus nitrogen footprint tool with the existing campus carbon calculator to provide universities with a broader picture of their environmental impact.

The nitrogen footprint is an important sustainability tool that communicates how our everyday choices

contribute to nitrogen pollution. Through individual and collective action, we can reduce our nitrogen footprints and help improve our environment.

### Endnotes

1. Figure 3: Leach, AM, AN Majidi, JN Galloway, AJ Greene. 2013. Toward institutional sustainability: A nitrogen footprint model for a university. *Sustainability: The Journal of Record* 6: 211-219.
2. Figures 1 and 3 Designed by Andrew Greene.

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