

Why Steam?

[Brief statement on the benefit of cooking with humidity control]

Water plays a critical role in almost all cooking. Sometimes it's obvious, like when boiling or steaming. But water's role is just as vital even when it's invisible to the naked eye, like when roasting a cut of meat or baking a batch of cookies. That's because the actual cooking temperature – the one that the food experiences – is governed entirely by the presence of water.

Traditional ovens only allow you to control the temperature of the air in your oven. In an oven with dry air and wet food, the temperature you set, say 350F, means very little to the inside of your prime rib roast.

So how can you control the temperature that the *food* experiences? Steam! When the air in the oven is full of steam, the temperature you set is the temperature your food “feels”. The Anova Steam Oven gives you control over both temperature *and* humidity. This combination is the key to perfect results, every time.

When cooking a steak, for example, we usually have two goals: cook the steak to the right doneness from edge-to-edge, and sear the outside to form a delicious crust. Controlling water is the key to achieving both goals. To create that crust, the surface of the steak must be dry – if it were still wet, it would only get as hot as the boiling temperature of water (212F) instead of reaching the 350F or so required for browning to start.

But, when we're cooking the interior of the steak, we don't want it to dry out. In other words, we don't want water from inside the steak to evaporate into the air. Lucky for us, air can only hold onto so much water. Once it's saturated, it won't take any more, and we call this point 100% relative humidity. If we cook our steak in an oven with 100% relative humidity, the water in the steak can't evaporate into the air. This keeps our meat juicy.

What is combi cooking?

For many foods we cook, we're trying to achieve two goals: perfect doneness on the inside, and a golden brown crust on the outside. But these goals are in conflict with each other. That golden crust requires the outside of the food to be dry, since wet foods don't brown. However, when we're trying to achieve perfect doneness on the inside, we want to keep our foods moist.

Combination cooking, or “combi cooking”, addresses this problem by cooking your food in steps or stages. To get that perfectly medium-rare steak or flaky fish, we cook with high humidity at low temperature. But when it’s time to add a crust, we raise the temperature and dry out the air so water on the surface of the food can evaporate off and give way to browning.

Dry Bulb vs. Wet Bulb

Your oven at home likely has one control knob for temperature. When you set your oven to 350F, you’re controlling the temperature of the air in the oven. This temperature is known as the “dry bulb” temperature – if you put a normal thermometer in an empty part of the oven, this is what it would read.

But most foods are full of water, not air. If you put a wet cloth over the same thermometer, it would give a different reading, because the heat from the oven gets diverted into heating the water in the cloth before it can act on the thermometer. This is called “wet bulb” temperature and it’s the most important part of cooking that cookbooks never teach you about.

Indeed, any food that has water in it – meat, fish, vegetables, bread, pastry – heats up according to the wet bulb temperature. Only when the food has been dried out does the dry bulb temperature take over.

So, your traditional oven that only controls dry bulb temperature offers very indirect control over the temperature inside your food. Knowing when your roast is done is still, unfortunately, a guessing game left up to the cook.

Why Humidity Matters

Wouldn’t it be great if we could *control* wet bulb temperature the way traditional ovens control air temperature? Turns out, humidity can help! When the air in the oven is saturated with steam, the wet bulb and dry bulb temperatures are the same! When this happens, we can set the temperature of the oven to the temperature we want the food to reach, just like we do with sous vide.

Benefits of Cooking with Steam

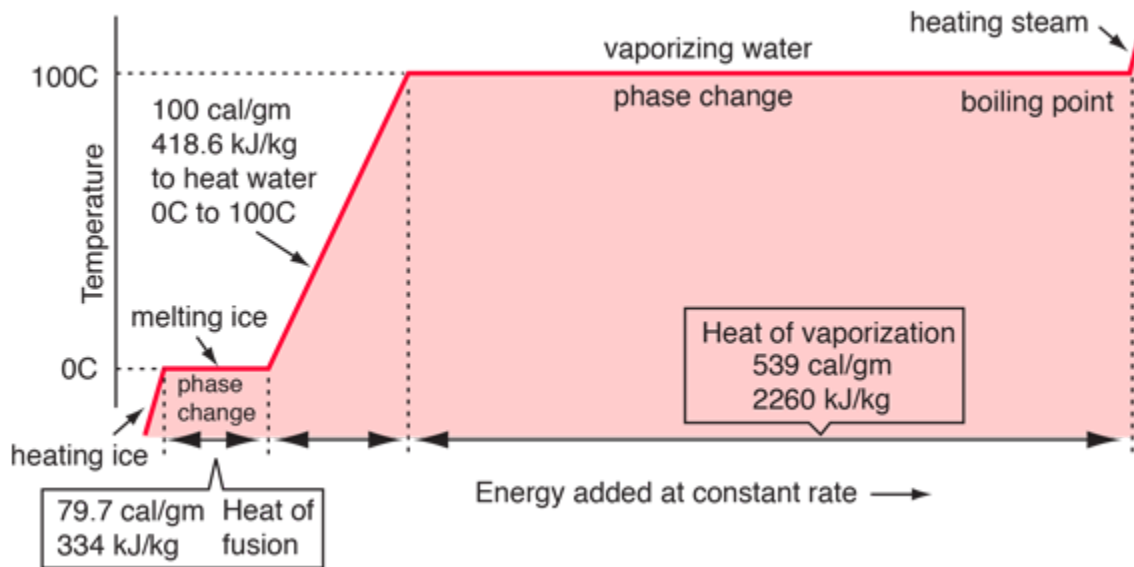
Faster Cooking

Temperature control isn’t the only benefit of cooking with steam. Humid air is a much better conductor of heat than dry air. That’s why you can comfortably sit in a dry sauna at 200F, but that temperature would : the water in the air conducts heat to your skin much more effectively.

By adding humidity to the air in the oven, **we can heat foods faster.**

How does this work? When we add energy to water, the temperature increases. As long as the water is still liquid, the increase in temperature is directly proportional to the amount of heat energy you put in. But when the temperature of the water reaches its boiling point, something strange happens. You keep adding energy, but the temperature doesn't change. You have to pour an incredible amount of energy into the water before it finally turns to steam.

This huge amount of energy represented by the plateau below is called the *latent heat of vaporization*.



[\[http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/phase.html\]](http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/phase.html)

So, how does this heat our food faster? When a water droplet becomes steam, it carries with it all this extra energy. But when steam condenses back into water droplets against the surface of food in the oven, all that latent heat gets transferred into the food.

[Steam vs. water vapor]

Sous Vide Precision

Sous vide is all about precise temperature control. Unfortunately, your traditional oven probably isn't that precise. To make matters worse, your traditional oven only knows about the temperature of the air, not the temperature of the food. It's up to you, the cook, to use expert timing to ensure your food isn't over- or under-cooked.

Cooking with steam lets us take advantage of the precision of sous vide, but with the convenience of an oven. Using humid air gives the oven more precise temperature control. When foods are sealed, as they are in sous vide cooking, water in the food has nowhere to go, so it stays put. In a steam oven, when the air is fully saturated with water, the same thing happens: with no dry spot to evaporate into, the water in your food stays in your food.

[with / without bag]

Health benefits

Potential topics:

- More flavor with less fat
- Nutrient retention? [Need source]

Compared to boiling, many vegetables *taste* better when steamed. Vegetables contain natural sugars, which are water soluble. When boiled, these sugars get carried off in the water. But when cooked with steam, the sugars stay put. Your corn tastes more like corn, and your carrots taste more like carrots!

[TODO]

Your favorite recipes, made better

The Anova Steam Oven lets you keep making all your favorite traditional recipes, only better. By controlling both temperature and humidity, you can keep your proteins juicier, cook your vegetables faster, and take your baking to the next level.

New possibilities, familiar form factor

Until now, steam cooking has been available only to high-end restaurant chefs. Dishes that require precise temperature control, like fish, eggs, and custards, are now achievable in a countertop oven.

Argument for replacing a microwave

Benefits by Segment

Food Nerds

You already know that precise temperature control is the key to perfect doneness, every time. Until now, sous vide has been the only way to achieve these results at home. And for some

foods, like a 72 hour short rib, sous vide remains the best way to cook. But for lots of other dishes, the Anova Steam Oven offers the same precision temperature control as sous vide, without the water bath.

Sous vide users also know that many foods aren't complete until they've been seared to develop a flavorful, golden crust. This means unbagging, drying, and cooking your food a second time over high heat – on a skillet, with a torch, or under the broiler. The Anova Steam Oven can switch from high-humidity, low-temperature cooking to dry, hot broiling. So, you don't need a second tool to complete your meal.

And, as wonderful as sous vide is, it doesn't offer much when it comes to baking. The Anova Steam Oven offers convection baking with precise temperature control to ensure your cookies, brownies, and scones turn out perfectly. But, using steam modes, you can also bake fluffy steamed buns, crispy baguettes, and perfectly cooked custards.

Other segments

Healthy Eaters

Make vibrant steamed and roasted vegetables. Retain more nutrients compared to boiling.

Families

Sit down to dinner when *you're* ready. Holding modes keep food warm, without overcooking or drying out, until it's time for dinner.

Cooking for a Crowd

[Sous vide version of this value prop is: water baths can scale up to cook tons of food; cook + hold means you can pull out and finish foods on-demand.]

[Possible variants here:

- “Cook and hold” lets you prep ahead of time, rather than bottlenecking to serve many hot dishes at once
- Large capacity of steam oven and many racks are perfect for hors d'oeuvres
- Can be used with vacuum-packed foods to hold warm, like sous vide
- “Steam refresh” prepared foods from room temp to warm

]

BBQ & Grilling

Achieve perfect doneness in steaks and chops by equilibrium cooking with precise temperature control. Then, enjoy the flavor (and romance) of open-flame grilling to apply a sear.

For BBQ enthusiasts, use long cooking times to break down tough cuts like ribs and brisket until they're fork-tender.

Small Spaces

In smaller kitchens, versatility matters. The Anova Steam Oven can replace your traditional oven, toaster oven, and even your microwave! Steam and convection speed up reheating leftovers (compared to conventional ovens). And with such a large cooking capacity, a little counter space goes a long way.

Cooking Modes

Dry

In Dry mode, the oven cooks using hot air with no added steam. This mode is identical to cooking in a traditional oven or toaster oven. This mode is the best choice for most baking – cookies, cakes, biscuits, scones, etc. – where your goal is to drive out water from the dough. Dry mode is also best for browning, and can be used before or after steam modes to add a golden crust to your foods.

Low Temperature Steam

Low Temperature Steam mode refers to cooking temperatures with added steam, when the temperature is below 212F. This may sound counterintuitive – how can we have steam at a temperature below the boiling point of water? In this context, we use the term “steam” to refer generally to humidity in the oven. Note that even though the oven may be running at 100% humidity, you may not see steam or fog inside. That’s because true steam is invisible! It’s only when tiny water droplets condense in the air that it becomes visible as fog.

This cooking mode is best for bringing proteins to a core doneness temperature. If you’re familiar with sous vide cooking, low temperature steam mode does the same thing. By setting an oven temperature at or just above the desired doneness temperature, we ensure our proteins don’t overcook and don’t suffer from a temperature gradient – nobody wants gray bands around the edges of their medium-rare steak.

By using high humidity in the Low Temperature Steam mode, we both speed up cooking time (because heat conducts faster through moist air) *and* we prevent our foods from drying out. When the air in the oven is already fully saturated with water, the water in the food has no choice but to stay put.

High Temperature Steam

This mode adds steam to cooking temperatures greater than 212F. This is useful for speeding up the cooking of vegetables, in particular, as the steam will conduct heat to the veggies faster than dry air would.

Getting Started Recipes

Salmon

Cooking seafood traditionally can be intimidating to some cooks: if your timing is off, even just by a little, your fillet can be under- or [gasp!] over-cooked. Not so here. By cooking the salmon at the temperature we want it to reach, and by monitoring the interior temperature with the probe, precise timing is no longer required for perfect results.

We use salt and sugar to quickly dry-brine the fish. The salt and sugar dissolve into the flesh, helping the salmon hold onto more of its juices as it cooks, and results in a pleasant, slightly firmer texture.

- X lbs salmon fillet
 - X tbsp salt
 - X tbsp sugar
1. Check that all pin bones are removed.
 2. Portion salmon ahead of time - it's easier to cut cleanly before cooking and can speed up the cooking process.
 3. Sprinkle salt and sugar equally on all sides of fillets. Cover with plastic wrap and refrigerate 30-60 minutes.
 4. Preheat oven to {130F} {100% Steam}.
 5. Insert the probe into the thickest part of one of the fillets.
 6. Cook until probe reads {123F for very lightly cooked} {126F for lightly cooked, recommended} {129F for firm}, about {25 mins}.

Serving suggestion: quick beurre blanc; tomato and shallot salad; teriyaki glaze; cajun seasoning

Steak

A great steak can be a considerable investment. The key to achieving perfect doneness on the inside and a glorious crust on the outside is to address those two goals in two different cooking steps. This no-compromise approach requires a little more cooking time, but the results are worth it.

- XX steaks [recommend NY Strip or ribeye]
- Soy sauce (or salt)
- XX Garlic cloves, smashed
- XX sprigs rosemary
- Butter

1. Preheat oven to {130F} {100% Steam}.
2. Coat steaks liberally with soy sauce (or salt).
3. Arrange steaks in a single layer on baking trays.
4. Insert the probe into the thickest part of one of the steaks.
5. Cook until the probe reads {122F for rare} {125F for medium rare, recommended} {127 for medium}
6. Remove baking trays with steaks.
7. Set oven to Sear mode and wait for it to preheat.
8. For best results, blot the surfaces of the steaks dry. Top with rosemary sprig, smashed garlic, and pat of butter.
9. Return to oven to sear until golden brown, about {XX minutes}
10. [If necessary, flip and sear on 2nd side]

Serving suggestion: pan sauce made from drippings; top with crumbled bleu cheese; slice and add to salad with goat cheese & candied nuts.

Eggs - Breakfast Sandwich

A hearty breakfast doesn't need to require a lot of work, or a pile of dishes. These breakfast sandwiches are made entirely in the Anova Steam Oven and make up to {XX} servings at once.

- XX Eggs
 - XX Heavy cream
 - XX Butter, unsalted, melted
 - XX Salt
 - XX Sausage patties [frozen?]
 - XX English Muffins
 - XX Cheese, sliced
1. Preheat oven to {175F} {100% Steam}.
 2. Arrange 3 trays
 - a. Egg cup tray (possible accessory) or tray with XX baking rings
 - b. Tray with sausage patties
 - c. Tray with english muffins
 3. Beat together eggs, cream, melted butter, salt. Divide among egg cups.
 4. Insert all three trays and bake for {20 minutes} or until eggs are fluffy and set.
 5. Top eggs with cheese and bake until melted {1 minute}
 6. Assemble breakfast sandwich.

Serving suggestion: add bacon; add hollandaise; add avocado; add hash browns; sub sausage patties for crab.

Add mix-ins to the egg patties: onions, peppers, chives.

Eggs - Rolled Omelet

[Inspired by Modernist Cuisine striped omelet - without the stripes]

Who says breakfast needs to be basic? This rolled omelet is a stunning way to serve breakfast, and is so easy that you may never reach for your omelet pan again. Steaming the egg mixture at just the right temperature creates an omelet that is set but still flexible enough to roll.

- XX Eggs
 - XX Egg yolks
 - XX Heavy Cream
 - XX Butter, melted
 - XX Salt
 - XX Ricotta
 - XX Chives, Parsley, Tarragon, Thyme, finely chopped [choose what you like]
 - XX Freshly ground black pepper
1. Preheat oven to {180F} {100% Steam}.
 2. Combine eggs, egg yolks, heavy cream, butter, and salt.
 3. Grease bottom of baking tray with butter. Pour egg mixture into baking tray(s) to create a $\frac{1}{8}$ " thick layer.
 4. Cook until set, about {10 mins}.
 5. Meanwhile, mix together ricotta, herbs, black pepper
 6. Remove egg tray from the oven and slice set egg layer into two halves. Top the middle with the ricotta mixture.
 7. Using a rubber spatula, pick up one corner of the egg layer and roll over the ricotta mixture, forming a tube. Repeat for remaining omelets.

Other fillings:

- Goat cheese, pancetta, minced shallot
- Ground breakfast sausage, maple syrup
- Avocado, crushed tortilla chips, jack cheese, hot sauce

Roast Chicken

[Need to determine if oven will hold a standard US-sized whole chicken. Depending on size and placement options, I may recommend doing a spatchcocked bird in two halves, as below.]

Great roast chicken is as simple as it is spectacular. But most roast chicken recipes are full of compromises that leave the meat dry, the skin rubbery, and the flavor bland. There are two secrets to fabulous roast chicken: cook the meat very slowly, and keep the skin as dry as possible. Slow cooking allows the meat to slowly approach perfect doneness without overcooking the outside and squeezing out flavorful juices. Keeping the skin dry allows it to get crispy in the final step.

- 1 Whole chicken
1. Preheat the oven to {165F} {0% Steam} {High Convection}
 2. Spatchcock the chicken, then cut into two halves. Discard gizzards and excess skin. Blot dry on both sides.
 3. Place each chicken half on an oven tray, skin side up.
 4. Place the thermometer probe into the thickest part of the breast.
 5. Cook until the probe reads {145F}, about {2 hours}. Remove the trays.
 6. Set the oven to {SEAR} {0% Steam} {High Convection} and allow it to fully preheat.
 7. Return trays to the oven and roast until the skin has browned and become crispy, about {5 minutes}.
 8. Carve and serve!

Notes: If you have the gear, injection brine the meat! Be sure to keep the brine off of the skin, and don't tear or poke through the skin during brining, or it will tear during cooking.

For extra crisp skin, prepare step 3 the night before and let the trays sit, uncovered, in the fridge. The dry air of the refrigerator will pull moisture out of the skin.

Serving suggestion: duck fat with herbs, garlic and parsley; mashed potatoes and demi glaze; biscuits and bechamel.

Crème Brulee

- XX Egg Yolks
 - XX Heavy Cream
 - XX Sugar
 - XX Salt
1. Preheat oven to {176F} {100% Steam} {Fan Low}.
 2. Arrange XX ramekins on XX trays.
 3. Combine ingredients and whisk until fully dissolved.
 4. Pour through strainer into ramekins, leaving ¼" at the top. Remove bubbles from surface with short blasts of a blowtorch, if you have one.
 5. [Need to test: cover with plastic wrap? May not be necessary]
 6. Bake XX minutes.
 7. Let cool at room temperature for XX minutes.
 8. Transfer to the refrigerator for XX minutes until chilled.
 9. Top each ramekin with XX sugar. Brulee with torch, holding the flame 6-12 inches away from the surface to avoid scorching.
 10. Rest XX minutes for sugar to cool and fully set.

11. Serve

Variations: Infuse milk with rosemary for savory creme brulee; Cereal milk version; Oreo cookie milk version; Variants for pot de creme, flan.

Steamed Buns

[TODO]

Barbeque

[TODO]

Broccoli with Cheese Sauce

- XX Broccoli, cut into florets
 - XX salt
 - XX pepper
 - XX olive oil
 - XX mild cheddar cheese, shredded or cubed into small pieces
 - XX milk
 - XX sodium citrate (optional)
1. Preheat oven to {200F} {100% Steam} {Convection High}
 2. Cover a tray with aluminum foil for easier cleanup. Arrange broccoli florets and coat lightly with salt, pepper, and olive oil.
 3. Bake {XX minutes}.
 4. Meanwhile, combine milk and [optional] sodium citrate in a small saucepan, whisking to dissolve. Heat milk over low heat until just simmering.
 5. Working a handful at a time, add cheese and whisk until fully melted.
 6. Once cheese is fully incorporated, remove from heat and set aside.
 7. Remove broccoli from oven and preheat oven to {Broil} {0% Steam} {Convection Low}.
 8. Pour cheese sauce over broccoli and return tray to the oven.
 9. Broil {XX} minutes until cheese is bubbly and has developed golden brown spots.
 10. Serve immediately. Remaining cheese sauce can be kept, refrigerated, {XX days}.

Variations: cauliflower and parmesan; broccolini and gouda; asparagus with garlic and feta.

Perfect Toast

[TODO]

Techniques In-Depth

Equilibrium Cooking

Equilibrium cooking refers to cooking foods at a temperature just above the temperature you want the food to reach. Sous vide users will be familiar with this way of cooking. Here's an example.

Suppose you want to cook your steak to medium-rare. This doneness – medium-rare – corresponds to a temperature of the inside of the meat, in this case about 125F. If you were to cook your steak on a grill or a skillet or even in a hot oven, the temperature of the cooking environment would be much hotter than you ever want the steak to get. So, it becomes your job as the cook to get your timing exactly right so you pull the steak from the heat at the *exact* moment that the interior temperature reaches 125F. If this sounds tricky, that's because it is. Depending on the thickness of the steak, the starting temperature, and a bunch of other factors, it can be quite a challenge to get that timing right.

Instead, suppose you put your steak in the Anova Steam Oven and set the temperature to 125F. The inside of the meat will *never* exceed 125F – it can never overcook! It will take longer for the steak to cook this way, but since you no longer need to worry about timing, the steak can hang out in the Anova Steam Oven, without overcooking, as long as you like. Rather than waiting anxiously by the stove, you can relax and eat on your own schedule.

Equilibrium Cooking is especially useful for foods that are very sensitive to temperature: meat, fish, poultry, and egg dishes all benefit greatly from precise temperature control.

Baking - Steam Injection

[TODO]

Steam vs. Sear

When cooking meats and poultry, we often have two goals: cooking the inside to the correct doneness *and* creating a golden brown crust on the outside.

Steam is great for achieving perfect doneness. The temperature of humid air can be controlled more precisely than the dry air in a traditional oven, and this translates to greater control over the temperature inside your food.

But to achieve browning, we need to switch from steam to dry air. Why? The browning reactions that create the golden brown color and mouthwatering flavor we associate with roasted meats happen at temperatures above 300F. If the surface of the food, or the air around it, is wet, that water creates a temperature limit of 212F - the boiling point of water. Until this moisture has been boiled off by heat, the surface of your meat and poultry is stuck at too low a temperature to

brown. This is why recipes commonly recommend patting the surface of steaks dry before searing.

The Anova Steam Oven can switch between steam-cooking and browning modes.

[Testing needed: sear-then-steam, or steam-then-sear.

Searing first lets us preheat the oven to high. Then using the residual heat of the oven to help flash water to steam, plus the energy that the cold food pulls out of the oven, we can drop the temperature to cooking temp fast.

But, steaming first means that there's potentially less temperature delta at the surface of the meat, which helps avoid gray bands. And, the crust is at its most crispy just after searing.

Testing will help illuminate the practical advantages of each approach. Note that this same debate exists for sous vide.]

Holding – Food Safety

[TODO]

Dehydrating

Beef jerky, kale chips, chewy apple slices, and fruit leathers are all miracles of dehydration. By driving out most of the water in foods, we can vastly extend their shelf life and create a whole new set of textures and flavors from familiar ingredients.

You might not think of a *steam* oven as your go-to tool for dehydration. After all, steam is wet, and we're trying to dry our food. However, the Anova Steam Oven's dehydration mode is perfect for this purpose. By gently heating and circulating the air inside the oven cavity and opening the vents, we create a very dry environment. The water in your food gets pulled to the surface where the warm air evaporates it away, slowly drying your food.

However, there's another useful trick hiding in this oven, too. Cooking raw foods at temperatures as low as those used for dehydration can introduce a food safety risk. For the greatest food safety, meats, seafood, and even sliced fruits should be blanched before dehydrating to kill off any bacteria that found their way to the food's surface. A quick blast of steam at the beginning of a dehydration cycle takes care of that problem, making your jerky and fruit chips safer to eat, without having to introduce another tool in the mix.

Proofing / Fermentation

Fermentation produces some of the most compelling flavors in all of cooking. For baking, in particular, giving your dough time to ferment is critical to both flavor and texture. However, the fermentation process is very temperature sensitive: at lower temperatures, fermentation slows,

and at higher temperatures, the process speeds up. Rather than rely on the ambient temperature of your kitchen, use the Fermentation mode on the Anova Steam Oven to provide both consistent temperature control *and* a properly humidified environment to prevent your dough from drying out.

Converting traditional recipes to the Anova Steam Oven

[TODO]

Sous Vide vs. Steam Oven

[Perhaps only for an internal audience. Still work-in-progress]

Sous vide excels at:

- Very long cook times (>4 hours, or when the water tank would run dry)
- Very large volumes (whole racks of ribs, cooler full of bags)
- Cook-chill: pre-cooking meals that remain bagged until ready to eat

Steam oven excels at:

- Delicate foods that can be crushed if bagged (fish)
- Foods that can't be bagged (creme brulee) or odd-shaped foods (broccoli, whole poultry)
- Things that need browning (skin-on poultry, roasted vegetables)
- Toast

Tossups:

- Skinless poultry
- Steaks - sous vide requires a second step to sear, but the steam will likely require the user to remove the food for the oven to preheat before searing