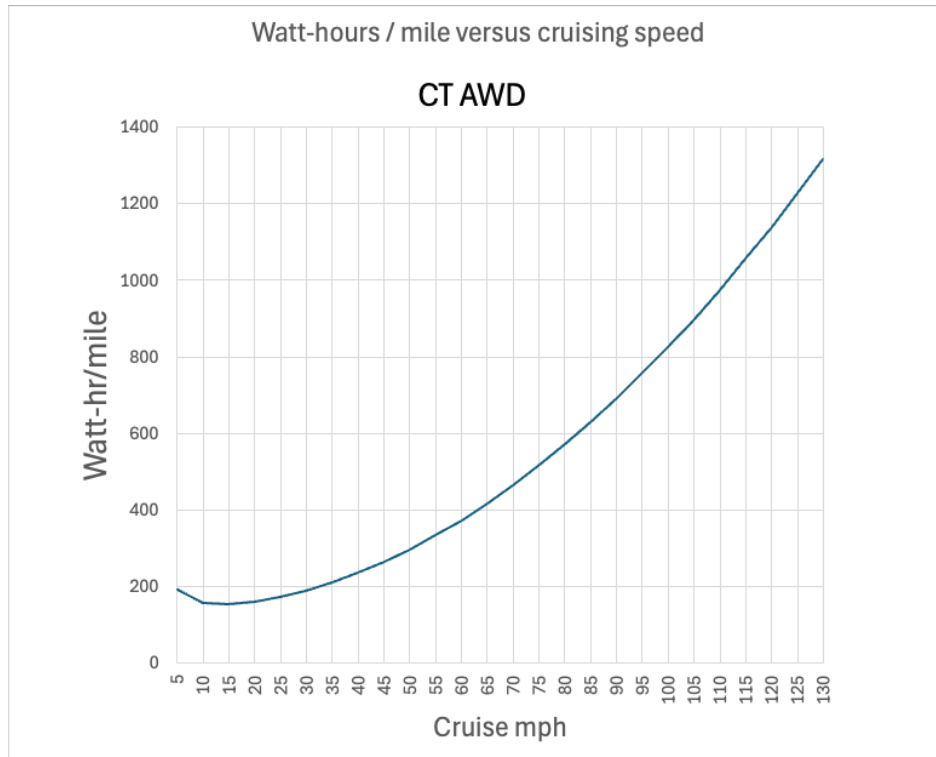


So in my “day job” I model general aviation aircraft aerodynamic performance supporting my company’s iOS mobile app “TLAR.” Turns out modelling car/truck performance is similar enough to an airplane on takeoff that I could import a lot of the aero goo we use on small airplanes for use modelling Tesla performance. I’d say we are “on to something” that likely has some errors. There is a saying in the analytical world, “all models are wrong, some are useful.” And that applies here.

Anyhow, modelled both the rolling drag and aero drag of various Tesla cars/truck, including “hooks” for trailering, elevation, uphill/downhill roads etc. This chart shows some of the key parameters.

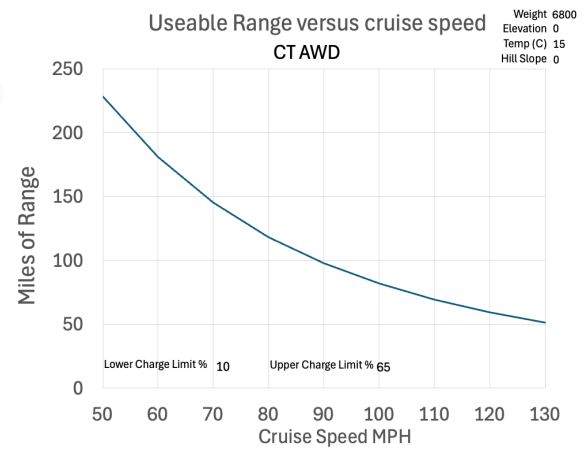
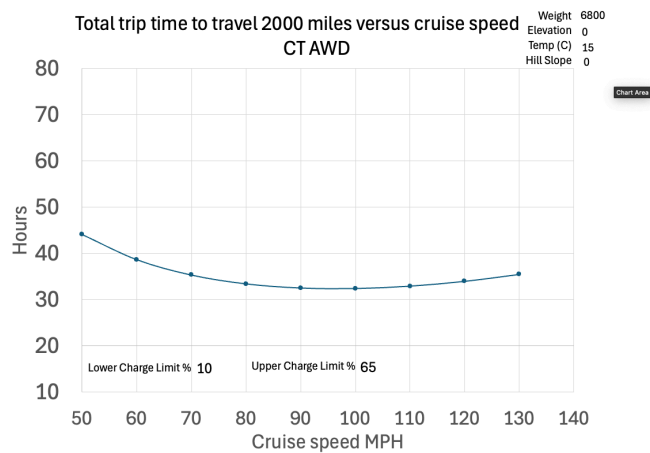
	CTAWD	1	2	3	4	5	6	7	8
Model	1	CTAWD	M3 LR (older)	M3 LR (new)	MY AWD LR	MS P	MSold	MX	CTCB
Cd	0.6	0.34	0.23	0.219	0.23	0.208	0.244	0.24	0.34
Frontal Area (ft2)	64.4	34.4	23.9	28.7	28.5	25.2	25.2	31.9	34.4
KwH Capacity	123	123	75	85	79	100	85	100	123
Motor kW	450	450	192			760			630
Max sustained kW	174.6								
Systems draw while driving (Watts)	400								
Road Slope (degrees, + is up)	0								
Elevation (ft)	0								
Pressure (inHg)	29.92								
Pa (ft)	1								
Temp C	30	14.9904254	StdC					389/65 Baseline	1.918125886
Delta C	15.00957463								
Da (ft)	1802.3	Ratio	SLRrho						
rho	0.002255966	0.94872429	0.00237789						
Empty Wt	6600	6600	3805	4030	4396	4802	4647	5148	6843
Payload	7200								
Cd increment for racks, trailers	0.26								
Frontal area increment for racks, trailers	30								
Gross Weight (lbs)	13800								
Max Sustained kW Ratio	0.388			Up/Downhill Drag					
Ptire (psi)	50	3.44738	bar	0.0		ft-lb-sec to watts			
Motor Efficiency	0.97					1.355818			

The watt-hours per mile are derived by converting pounds of drag (rolling plus aero drag) to ft-pounds/sec to watts to watt-hours/mile using a 97% motor efficiency rate. Then, adding the watt-hours/mile needed to run “systems” like on board electronics, HVAC etc assuming a 400 watt burn for these systems. Here is the resulting CT AWD watt-hours/mile curve for a 6800-pound AWD CT at various speeds at sea level, 15C (59F), baro 29.92 inHg, level pavement no wind :

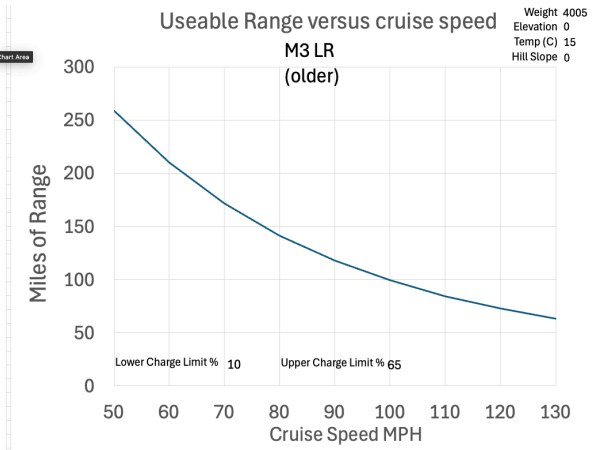
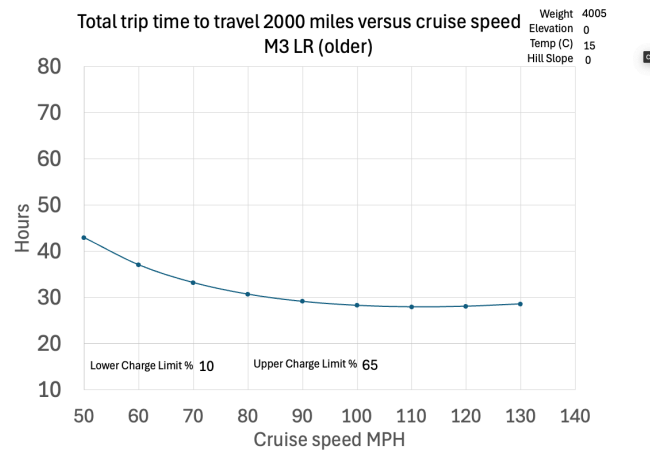


You'll notice these are close to what @Mongo posted earlier in this thread (his numbers were 400wH/mi @ 65 ish mph, 700 @ 90 ish, 1000@112ish, and 1250@130ish). Using this energy model, we can produce some interesting (useful?) results.

First, total time to drive 2000 miles in an AWD CT on level pavement, empty, except for 200 pounds of stuff (which includes the driver, so essentially stock with a driver and that's it), sea level, 59F, baro pressure of 29.92 inches Hg. Assumptions are 5-minute total "admin" time to get off freeway and get on charge, plus time to unplug and get back on freeway and a 10% low 65% charge limit. The charge model matches this site exactly (https://evkx.net/models/tesla/cybertruck/cybertruck_awd/chargingcurve/), so, if it's wrong, so is the modelling. The "least total time" speed to go 2000 miles under these conditions is 95 mph and requires a supercharger every 90 miles (more on useable range later).

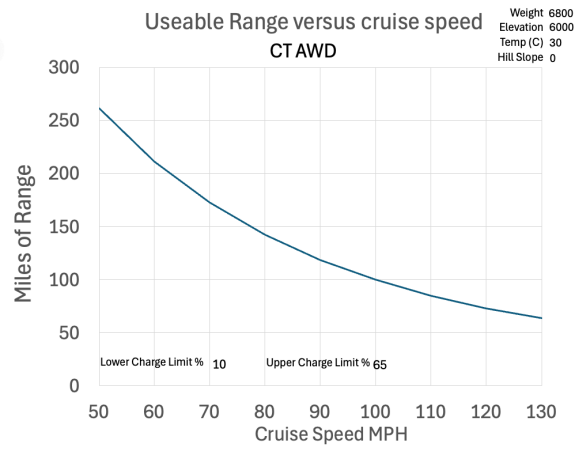
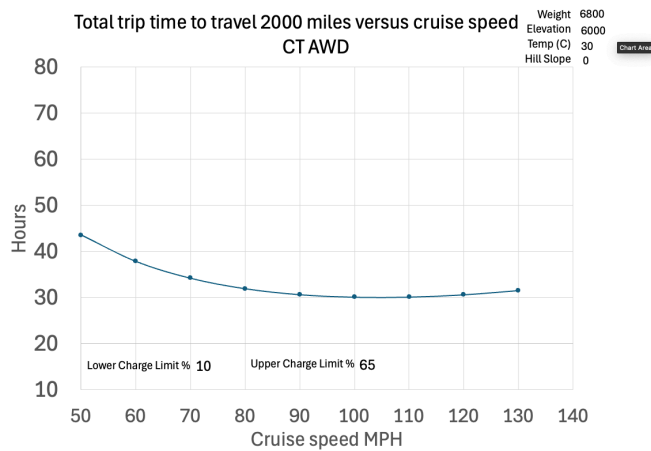


@Beetlebug62 posted his Model 3 LR data which was interesting as it brought into the conversation the differences between models of Telsa cars/truck. The M3 is more aerodynamic, weighs less, has a different frontal area, different battery capacity, different motor, different charge rates....it is very much apples and oranges. The result of all those differences is the following chart which shows the same total time to travel 2000 miles, but using M3 data.

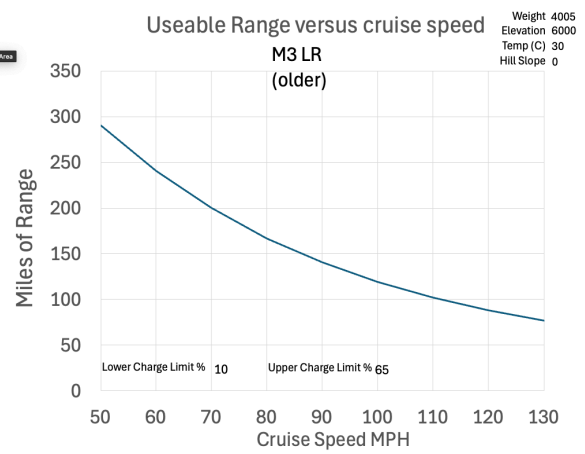
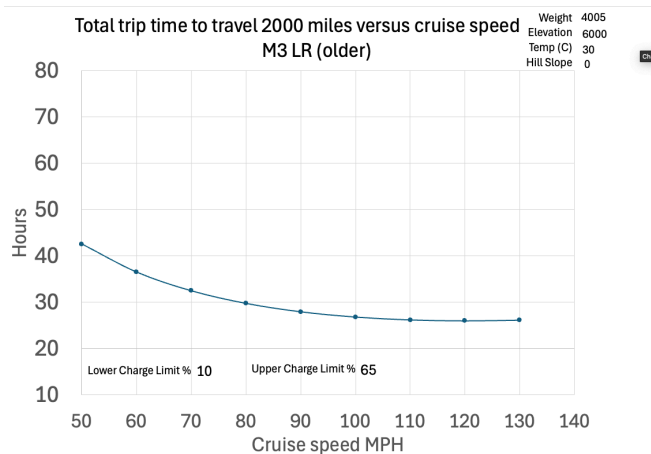


As you can see, the 2018 M3 LR has a higher “least total time” cruise speed of about 110 mph requiring a supercharger every 85 miles under the same conditions. It’s also arrives ~2 hours sooner than the CT on the same journey owing to its more energy efficient design. This also means that for nearly all drivers, the faster you go the more time you save as setting the cruise faster than 110 mph in the USA is illegal and could land you in jail depending on where you got pulled over!

Let’s go to Colorado for a moment on a hot day. Changing to 6000 feet elevation and 30C (86F), 29.92 inHg, level paved road. Here’s the CT AWD:



The best speed rises to 100mph and requires a supercharger every 100 miles (note: further distance and faster speed compared to sea level). Here’s the 2018 M3 LR under the same conditions:

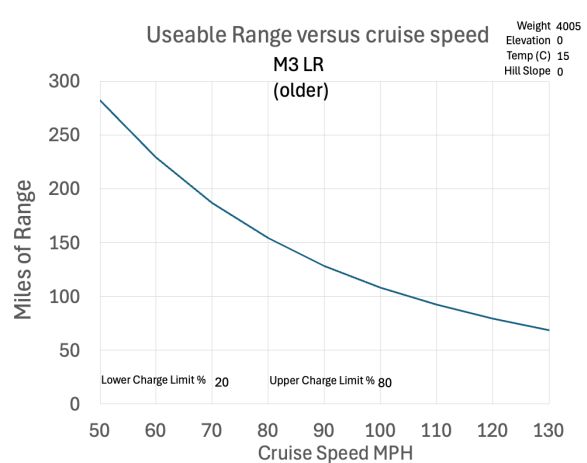
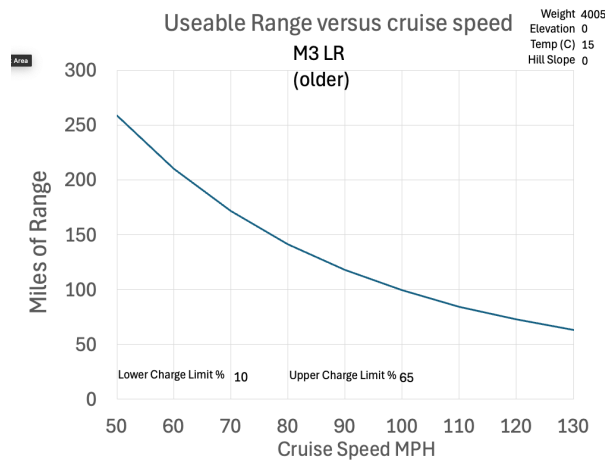
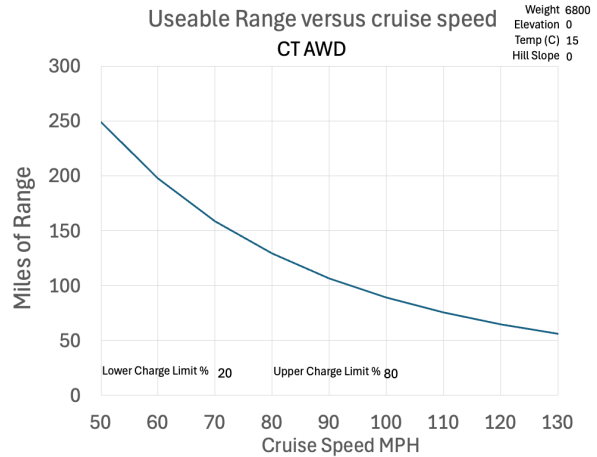
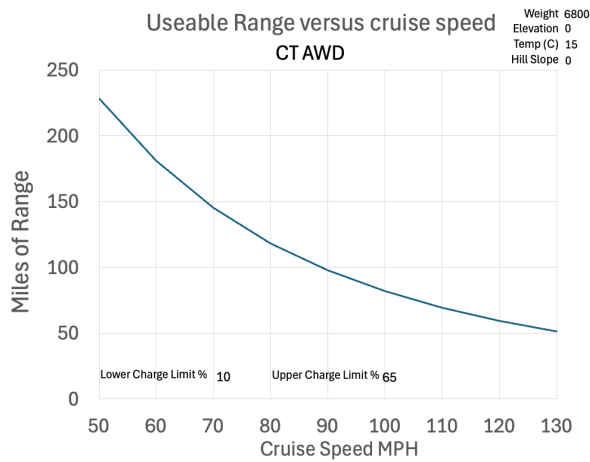


The best speed rises to 120mph and requires a supercharger every 88 miles (both increases). Returning to distance between superchargers.

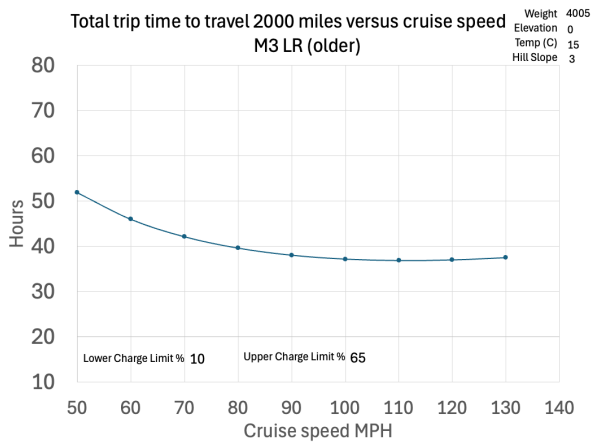
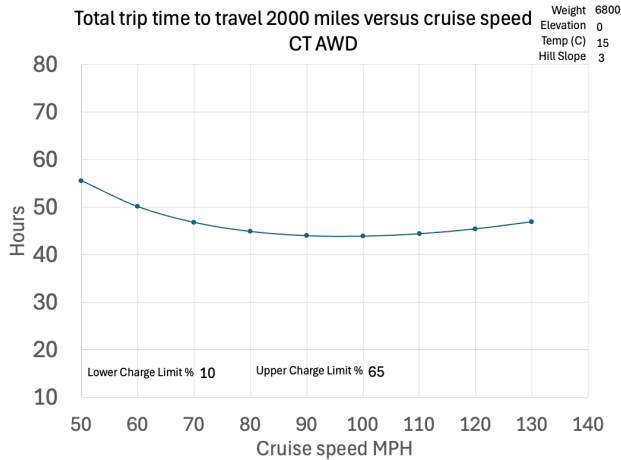
I searched for “median distance between superchargers” or other searches like that. Unfortunately, I didn’t find conclusive data on it. There is a lot of snippets and what not. The “AI” overview says 100-150 miles but varies by region with a federal goal of reducing that to 50 miles. There used to be a 312-mile gap between Gaylord, MI and Green Bay, WI. But according to google maps, that stretch is long since been filled in with several SCs along the way. Same with a 315-mile gap between Bend, OR and Boise, ID. This one I know is no longer as I drove that exact route when we bought my wife’s Model Y in Bend and returned to our home in Boise. There is a supercharger midway on that journey. Isolating to Interstates only, the longest gap may be the 155-mile gap between Southhaven MS and Sikeston MO, and a google maps search along that route seems to confirm it still exists.

As you increase speed, your useable range goes down (duh!). But, depending on your speed and your charging strategy, this range can get so short that you cannot make it to the next charger. Here are the useable range charts at SL elevation and 15C (59F) for the CT and 2018 M3 using a 10%-65% strategy and 20%-80% strategy:

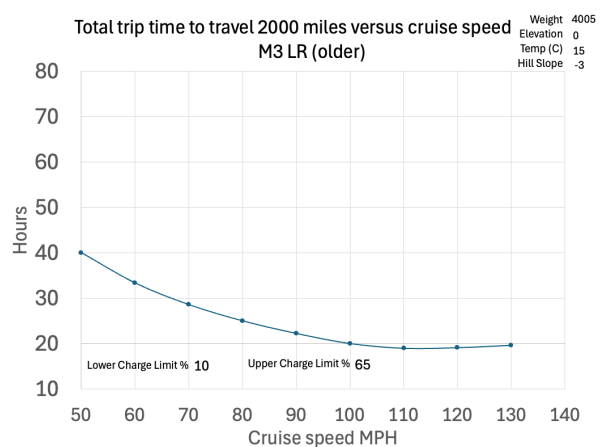
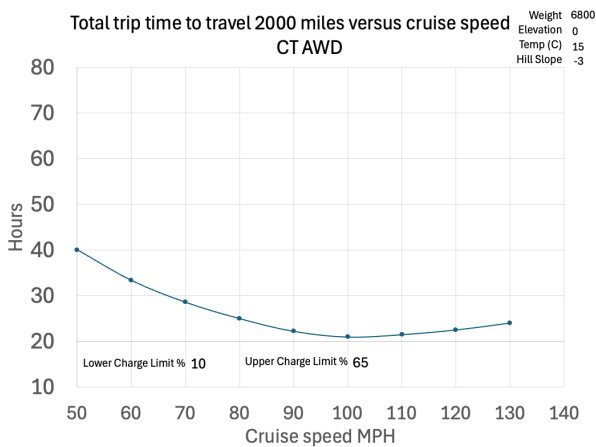
If you happen to charge in Southaven and are driving through Sikeston along your way, your speed is range limited to about 68 mph using a 10-65 charge strategy and 72 mph using a 20-80 charge plan.



A few more excursions. What about hills? This is an academic discussion obviously as you can't drive uphill or downhill for 2000 miles in the US (or anywhere else for that matter). That said, it's interesting that the best speed remains constant going uphill in terms of minimizing total time but going downhill it pays to speed up. Here are the CT and M3 charts going up and then down a 3-degree slope (5.2% gradient):

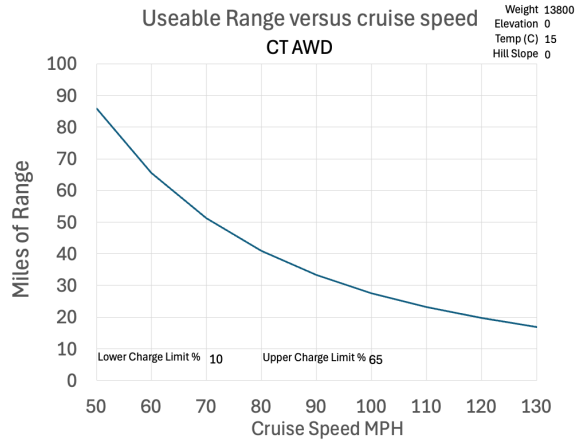
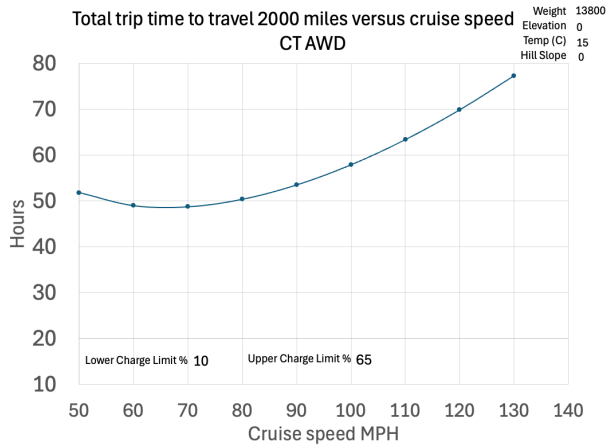


You'll note that going uphill the best speed remained the same, 95 mph, for the CT, and 110 mph for the M3. Here are the downhill charts:

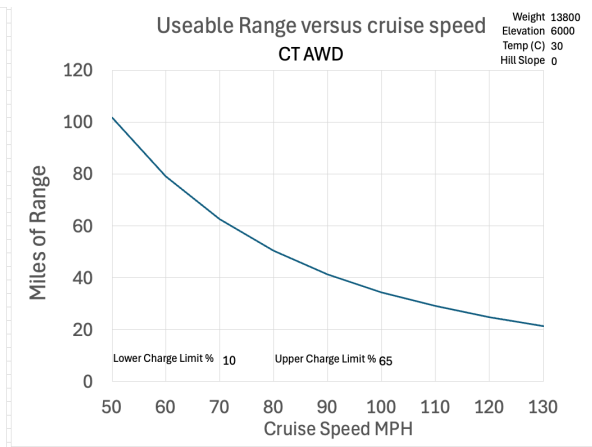
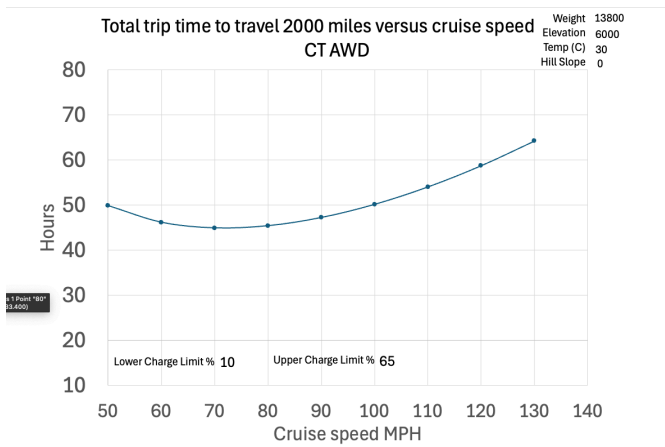


100 mph for the CT and about 115 mph for the M3 (both increases).

Finally, let's look at towing a 7000 lb RV with an 8ft wide by 8ft tall profile using an AWD CT. Here's its best speed chart and useable range chart at sea level, level, 15C (59F), and 29.92 inHg:



And, here they are at 6000 feet and 30C (86F):



Predictably, towing causes the best speed to decrease if the goal is to go long distances in the least amount of total time.

So, to wrap it all up. I contend that there is a speed for Teslas (and all EVs) at which going faster will cause you to arrive later than if you had slowed down. This speed is fast at sea level (95 mph in a CT, 110 mph in a M3) and increases as air density goes down. In general, this exceeds the speed limit by a wide margin, so it's safe to say for practical purposes if you want to get there sooner push the tron pedal down and be ready for a speeding ticket! However, when towing or on stretches with long gaps between superchargers or stretches with low powered charging (less than 250 kW), the best speed slows into the "normal" range at/near/below the posted speed limit.