Summary

Proposed ebike legislation H.100 / S.66 is a good attempt in the effort to standardize ebike rules across the US, but it has several problems that should raise questions, and changes made before it is accepted. Some of this proposed legislation has been driven by manufacturers and industry, and doesn't fit custom made or DIY types of bikes very well. Some of it also doesn't make sense for any ebike.

Three larger issues that should preferably be removed:
- Class 1 and 3 throttle ban- "a motor that provides assistance only when the rider is pedaling"
- H.100 / S.66 motor cut out above 20 mph, (as well as H.100 / S.66 "reaches the speed of " instead of the CPSC's "is less than")
- "A person shall not tamper with or modify...unless the label is replaced", the 'after repairs' labeling

Three smaller issues that should be changed:
- "less than 750 Watts" instead of "less than a nominal 750 Watts"
- unclear terms in "is not capable of providing assistance" and "ceases to provide assistance"
- "and" instead of "or their" in "Manufacturers and distributors of electric bicycles shall apply a label"

Background information

This 3 class system for ebikes is a logical extension of the generally accepted 20 mph limit for ebike assist, but it was written by industry to fit the standard mass produced upright riding position bike, and it does not fit an aftermarket DIY kit, an owner doing their own maintenance, recumbents and velomobiles, or an analog DC drive motor system very well. It also is in conflict with the Federal Consumer Products Safety Commission rule, can be misinterpreted, and is also is on the restrictive side for future active transportation goals.

I started thinking about the legal rules for ebikes around 2010 when first working on bikes as a town energy committee project. (I've now built 19 ebikes, and helped many others build their own.) Because my projects were both very public (I've now given well over 1000 test rides on my custom ebikes), and for liability reasons, I've actively tried to meet existing standards. There were basically two rules to meet (besides the manufacturing standards), the Federal Consumer Product Safety Commission rule (CPSC 1512 as amended in 2002) and the many diverse state motor assisted bicycle laws, which were originally meant mainly for gas motors added on to bicycles, (a good summary of these can be found in the NITC report "Regulations of E-Bikes in North America" NITC-RR-564, August 2014). The US ebike market was very splintered back then with dozens of state laws causing many different objections to ebikes, and a uniform ebike rule across the US was needed. The first step was the 2015 California legislation AB1096-92, which introduced the 3 class system that is the basis of H.100 and S.66.

The Federal CPSC rule is a very workable definition of an ebike, it's big limitation was that it applied only to the first sale of an ebike from manufacturer to consumer, and did not take the place of a state motor vehicle code. Here is the wording:

"*A two- or three-wheeled vehicle with fully operable pedals and an electric motor of less than 750 watts (1 h.p.), whose maximum speed on a paved level surface, when powered solely by such a motor while ridden by an operator who weighs 170 pounds, is less than 20 mph.*"

The CPSC wording does not say:
1. that the motor must cease to operate above 20 mph if the rider also pedals to increase the speed, only that 20 mph is the maximum motor only speed.
2. that a smaller operator with less wind resistance is not allowed to go faster than 20, and while this increase may be marginal (1 to 2 mph), it does not establish a hard limit at 20 mph.
3. nor does it say 750 Watt motor *output,* in other words you can put more than 750 Watts through a 750 Watt nominal motor, as may occur routinely with brief current surges or a fully charged battery.

While the CPSC definition was not a motor vehicle code, it was able to supercede state laws during the first sale of an ebike, thus effectively defining the market:
"*Pursuant to Executive Order No. 12988, the Commission states the preemptive effect of this regulation as follows. Section 1 of the Act provides that its requirements "shall supercede any State law or requirement with respect to low-speed electric bicycles to the extent that such State law or requirement is more stringent than the Federal law or requirements referred to in subsection (a [the Commission's regulations on bicycles at 16 CFR part 1512].*"
Thus it is legal to sell ebikes that do not shut off the motor above 20, can go slightly faster than 20 with a smaller rider, and may occasionally put more than 750 Watts through the motor. This conflicts with the proposed Vermont legislation.

The 3 classes of the California regulations were designed to appease the "a bicycle with a throttle is a motorcycle" opponents in order to create a more uniform market, and also acknowledge that there were already a substantial number of ebikes in existence that could travel faster than 20 mph (known now as Speed Pedalecs).

While 3 classes are more cumbersome than CPSC's one, it is better than other systems that were being proposed around 2010, such as authoritarian restrictions proposed by Ed Benjamin of LEVA in Florida, or similar European Type Approval rules that were being obsessively proposed by a study group in the UK. Over time these more extreme positions have mellowed, and in light of the new recognition that active transportation must play a larger transport role, the EU Transport Research Laboratory has now recommended to the European Commission that ebikes remain outside the scope of the next EU Type Approval legislation, with the Confederation of the European Bicycle Industry (CONEBI), Cycling Industries Europe (CIE) and the European Cyclists' Federation (ECF) supporting this recommendation. In addition LEVA-EU is now recommending that all Light Electric Vehicles / Personal Mobility Devices up to *50 kph (31 mph)* (my emphasis, because regular bicycles can and do travel faster than the proposed 20 mph limit under consideration here) be taken out of the EU Regulation No 168/2013 and the Machinery Directive, and have their own directive. These actions place the proposed language in H.100 / S.66 fairly far behind the curve of developments in bicycle technology (especially for cargo bikes), and for use in transportation emissions, energy, and climate planning.

It should be remembered that the 2015 California AB1096 rule was primarily sponsored by the Bicycle Product Suppliers Association, and only later did People for Bikes and Calbikes join them. Fortunately the changes that BPSA made to the CPSC definition are not as flagrantly pro industry as has happened in Germany (such as the industry and dealer associations ZIV/VSF guidelines for approved ebike repair parts, and the Bosch motor anti tamper measures), or France (a 30,000 Euro fine for modifying an ebike), because these types of measures prevent owner built projects or maintenance, small businesses from building ebikes, or shops from modifying ebikes similar to the work that garages are allowed to do on cars. The proposed 3 class system with labeling however still fits the factory built ebike market much better than it fits the owner serviced ebike, DIY ebike, or other non-factory ebike usage.

Questions raised by this legislation

The wording that we have thus inherited in H.100 / S.66 has problems, and here is an explanation of changes that should be made. I'll start with the two most serious, as they call this whole legislation into question, then two of medium importance, ending with a couple of almost typo category issues.

1. Page 3, Class 1 and 3 throttle ban: "a motor that provides assistance only when the rider is pedaling" should be changed. The 3 ebike classes should be reduced to 2 (class 1 and 2 should be combined), and throttles should be allowed on all bikes at a reduced power or speed. While some riders may abuse the use of a hand throttle, it is useful for:

a. Getting started from a stop at a difficult intersection or heading uphill
b. Getting started from a stop with a heavy load on a Cargo bike
c. Getting started from a stop on a recumbent or in a velomobile, which are harder to get going
d. People with bad knees or hips

A much better solution than getting rid of the throttle is to limit it's power or speed, for example to half power or to 10 mph. People are trusted with hand throttles on the 3 wheel electric shopping carts in department stores, it is not appropriate to remove them from ebikes because of the fear that teenage boys could misuse them. The thought that ebikes with hand throttles are motorcycles actually doesn't make sense, as 1 h.p. does not turn a bike into a motorcycle. While removing the 3 classes based on hand throttles may ruin this legislation, it allows many users to have an assist in difficult situations.

2. Page 3, "is not capable of providing assistance" and "ceases to provide assistance"
This wording should be removed since both are contrary to the CPSC rule which allows assist to continue above 20 mph. It should state only "the maximum speed when powered solely by the motor is less than 20 mph" for Classes 1 and 2. Here are three examples of why it should be removed:

a. In traffic in a 25 mph zone, I've found it safer to ride at 25 mph rather than at 15 to 20 mph where cars almost always try to pass me. This is possible because my bikes were built to the CPSC rule and continue to provide assistance (at 750 Watts) above 20 mph, and I'm then able to pedal enough to increase the speed to 25 mph to match traffic. Riding with traffic I'm also able to reliably take the lane, and get out of the door zone of the parked cars, which also increases my safety. (Acceptable bike lanes would be better, but they often don't exist and aren't coming.)
b. *Regular bicycles without a motor can travel faster than 20 mph.* It is not possible to tell if a rider is using a motor to travel above 20 mph under many circumstances, especially for recumbents and velomobiles. In a street setting it is not possible to enforce this rule, and this glitch opens the door to an enforcement problem and potential abuse by law officers who want to detain a bicyclist.
c. None of the six popular hub motor kits I've used could turn off above 20 mph as provided, and only 3 had the possibility of adding an external controller to do so. Only the bottom bracket motor kits have been able to turn off. This creates a legal obstacle for many hub motor DIY projects, and skews the market towards factory ebikes by removing many hub motor kits.

If these two phrases are not removed, they are also a vague obfuscation that should at least be made to match, but a better choice is to remove this requirement.

3. Page 3, "reaches the speed of 20 mph" is poor wording. It is semantically possible to pedal to above 20 mph and then use the motor above 20 mph, and only when deaccelerating and "reaching" 20 mph must the motor cut out again. While the CPSC phrase "less than" would be more concise, it is better to remove this limit on assistance as stated in the previous comment #2, and simply use the CPSC wording of "is less than 20 mph (under the specified conditions)" for Classes 1 and 2. Or to maintain the intent of the proposed legislation, the phrase could read "not over 20 mph".

4. Page 7, "(h) A person shall not tamper with or modify an electric bicycle so as to change the motor-powered speed capability or engagement of an electric bicycle unless the label indicating the classification required in subsection (g) of this section is replaced after modification."
This labeling is basically meaningless. Labels can be counted on to be correct only for factory built Ebikes when sold new. This 'after repairs' labeling clause should be removed and only the "Manufacturers and Distributors..." 'new bike' labeling requirement kept because:

a. an individual or a repair shop will often not have the testing capability to characterize an Ebike system to produce a valid updated label. At best they will install a generic label supplied by a component manufacturer which most likely will not be accurate, undermining this rule.

b. the main purpose of this label is for use by land management personnel or law officers overseeing municiple bicycle infrastructure, and since it is not possible for them to distinguish power ratings of a motor or battery by visual inspection in the field, any label could be valid, continually undermining the value of a label.

d. It is also not possible to tell if an ebike has been modified via it's software unless access to it's programming is available, and several ebike manufacturers (such as Bosch) have made their software tamperproof, requiring extraordinary access, again rendering the validity of any label questionable after repairs.

e. Labeling is also open to improper use by police during a profiling incident, via claiming the labeling is wrong, or misestimating the speed, and could be used as a technicality to seize a bike, similar to the seizures by NYC police in the past of delivery person's bikes.

The best use of a label is at first sale on a factory built bike, and after that it should not be expected to be valid and therefore this second labeling requirement for 'after repairs' should be removed.

5. Page 3, "an electric motor of less than 750 Watts" is an imprecise criteria allowing for biased testing leading to enforcement problems, and the word "*nominal*" (i.e. "name plate rating") should be inserted to read "an electric motor of less than a *nominal* 750 Watts".

If an ebike is tested with a fully charged battery in a test setup that will absorb more than 750 Watts of power, almost surely it will produce a surge of power that is above 750 Watts and fail this requirement as written. However if a person were to try to ride continuously under these maximum conditions, either the battery would quickly fail or the motor burn out. This is the difference between a surge or Peak rating and Continuous Duty (i.e. nominal) Rating. It should be stated in this legal wording that nominal conditions are used for testing and enforcement purposes.

The lithium batteries commonly used in ebikes have a voltage range of 3.0 to 4.2 Volts for each cell, from empty to fully charged. The nominal rating is taken in the middle, usually at 3.6 or 3.7 Volts, and is the best representation of the amount of energy stored in the cell. To base a rating on 4.2 Volts would overstate the capacity of the cell and be a false advertising claim, as well as not be accurate for engineering purposes. However if a battery pack with a nominal 48 Volt output is fully charged, the output becomes 54.6 Volts, which will then drive a motor with windings built for 48 Volts at more than 750 Watts.

Similarly the power rating of a motor is based not just on the wiring, or size of shaft and bearings, but also on it's ability to withstand heat. More than 750 Watts can be put into a nominal 750 Watt motor under a surge or peak condition, but this thermal overload would burn it up in short order if operated continuously in this condition. Despite the motor having a capacity of more than 750 Watts during peak conditions, the correct advertising and engineering rating is the nominal 750 Watt rating.

(A side concern is that changing the wording to "750 Watts *output*" would most likely exclude people from building cargo trikes using DC analog control (brushed) motors, such as used on golf carts or some forklifts, because their output can erratically surge, and is smoothed out only by vehicle mass.)

Thus it's important to state that testing or rating is under nominal (i.e. Continuous Duty) conditions, preventing incorrect testing under Peak conditions.

6. Page 6, "Manufacturers and distributors of electric bicycles shall apply a label" should be "Manufacturers *or their* distributors of electric bicycles shall apply a label", i.e. not both parties

Conclusion

The simpler language of the original CPSC rule, or the present Vermont law, or even that proposed by Representative Maida Townsend (S Burlington) in H.542 in 2016 (incorporated into S.225) is in many ways preferable to these bills. While 20 mph is a generally accepted electrical assist limit that is reasonable (it could be higher for future commuting purposes, which is partly addressed by the Class 3 category in this legislation), the proposed bills are an overly complicated fix for the simple concern of speeding, which given the speed that regular bikes are able to travel is not logical. For comparison, cars and motorcycles are allowed to have as much horsepower as the owner wishes, and what matters is how it is used.

I'm sure that there is room for improvement in my analysis, and that I have not covered all the different views of this legislation, but a few of these questions are serious enough that I hope H.100 / S.66 is either reworded or kept in committee for another year for further discussion. Bring in other testimony from the parties involved, remove the unneccessary restrictions, tighten up the clauses that could be misinterpreted, reduce the chances of biased usage by hostile authorities, and also bring it more in line with the CPSC rule. This bill should not be automatically voted out of committee, which would only serve the large ebike manufacturer and trade interests, and disadvantage several smaller segments of the market (such as DIY bikes, owner maintained bikes, hub motor kits, DC analog drives, cargo bikes, and handicap assist), leaving them with large difficulties to deal with.

Thank you,

Karl Kemnitzer
58 Densmore Hill Road
Hartland, VT

kkemvt@gmail.com