Volume - Issue
11-05
March 2024

Mobility Industry
Insights by
Michael L. Sena

THE DISPATCHER

IN THIS ISSUE

THE MARCH 2024 ISSUE IN BRIEF

THE BOOK, THE REAL CASE FOR DRIVERLESS MOBILITY, sums up everything its two authors have been doing and thinking about professionally for the past 55 years. Alain L. Kornhauser and I were fortunate enough to find a publisher, ELSEVIER, who let us put our thoughts into print. Now the work begins to put the words into action. There were many contributors to this book. All of those readers of *THE DISPATCHER* who have sent me their comments over the past eleven years have helped me to formulate my own thoughts. The articles they sent, I read. I clicked on the URLs they passed on. Many of these readers were clients I have had during my forty years of consulting, and we have continued the journey together when the assignments ended. Participants in the *SmartDrivingCars Summits* organized by Alain for the past seven years have all been involved in one way or another in preparing the groundwork, planting the seeds, and nurturing the growing the ideas included in the book.

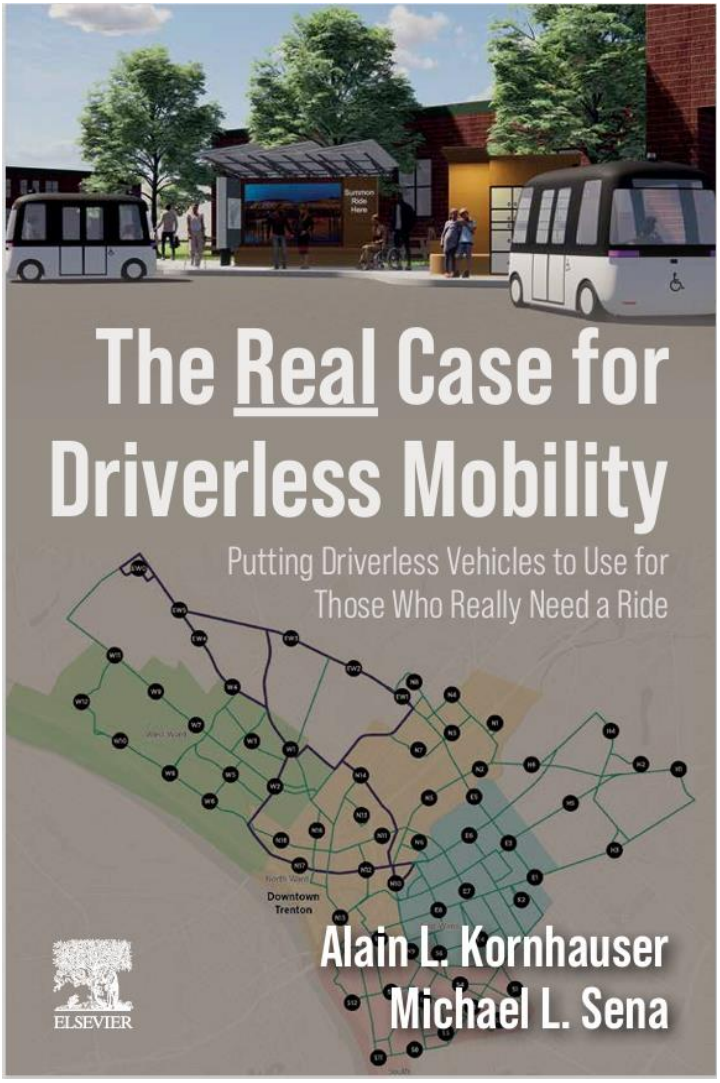
It turns out that our book was released at the same time as both WAYMO and CRUISE, two companies at the forefront of driverless technology, experienced setbacks in San Francisco. The latest, the torching of a WAYMO vehicle stuck in traffic with no driver or passenger, highlighted the fact that many people see them as playthings for the rich, serving no purpose for the common man or woman. WAYMO chose to have its vehicles in the same city that blocked their private buses carrying their employees from affordable housing in the city to their premises in Silicon Valley. They should have understood the importance of everyone seeing value in what they were doing. This is our point. You and I don't need driverless vehicles because we have a car or two (or three) at our disposal. The only thing a driverless car has that cars with drivers have is something they don't have: the cost of the driver. It's not a riddle; it's not rocket science; it's basic economics. Driverless cars are not for the wealthy, or even the moderately well off. They are for those who need rides but cannot afford them. That is the message in our book, and that is why it is timely.

THE DISPATCHER

Mobility Industry Insights by Michael L. Sena
March 2024 – Volume 11, Issue 5

The Real Case for Driverless Mobility

THIS BOOK IS the result of career-long activities in which Alain Kornhauser and I have been engaged in highly automated and connected vehicles, and in particular the five PRINCETON SMARTDRIVINGCAR SUMMITS. The SDC SUMMITS were initiated in 2017 by Alain, the founder and head of PRINCETON AUTONOMOUS VEHICLE ENGINEERING (PAVE), to find a solution to the problem of providing mobility for the unserved and underserved, including those who cannot drive themselves, cannot afford the transport alternatives that exist for them, or who live in areas where, for either economic or other reasons, neither public nor private forms of transport are offered. In 40% of the rural communities in the United States there is no form of public transit whatsoever. Two-thirds of the cities in the U.S. with populations of 100,000 or more have fewer than 200,000 residents, and many of these cities have lost both residents and jobs during the past fifty years. There are over 4,000 cities in the U.S. with populations between 10,000 and 100,000, and several of them are cities like Trenton, NJ, with a current population of 82,401 that at its peak in 1950 had 128,000 of residents. A high percentage of the residents in many U.S. cities have incomes that are below the U.S. Census poverty threshold. The jobs that have remained in the regions where



the cities are located are not in the city's core and are not easily reached by public transit systems. Most transit systems struggle to deliver an acceptable level of service with their limited budgets. While 57% of people living in Manhattan take public transit to their jobs, the U.S. national average is 5%, of which 2.3% is by bus and 1.9% by rail transit. Fully 85% drive to work, 76% drive alone and 8.9% drive in a carpool.

Mobility is concerned with making individual choices about where we want to be at a particular time. In the end, we choose where to go, where we most want to be, or where we most have to be. The desire or the need is personal, and the ranking of the alternatives—which of the possible destinations has top priority, and which methods of travel one can take—involves a myriad of elements and dimensions. From a mathematical optimization framework, it involves numerous dimensions with non-stationary weights assembled non-linearly into an order set from which a best is revealed and enacted as the individual's reality. In that reality, many choose to drive because it is more comfortable, more convenient, more flexible, and more economical overall than any available alternative. Others choose to drive because there is no other alternative. They drive because they must. In some places, without a car or a ride, you cannot work.

This is what the SDC SUMMITS have been attempting to address. During the first three SDC SUMMITS, all held on the PRINCETON UNIVERSITY campus in the month of May, several dozen experts working in the many fields of mobility and transport gathered to present and discuss their ideas on various approaches to solving the problem of mobility for the non-mobile. Due to COVID-19, the 2020 4th SDC SUMMIT was postponed and then held remotely during the course of five months, from December 2020 to April 2021. At the close of the 4th SDC SUMMIT, Alain presented a proposal to set the wheels in motion to make a concerted attempt to test the theories discussed during the SUMMITS and put all of our collective knowledge to use in a real proof of concept. Alain suggested that Trenton, New Jersey would be an ideal location for such a test.

The proposal was to assess whether driverless vehicles, that is vehicles that are driven without the involvement of a

human driver, either directly inside the vehicle or remotely at a command and control center, can deliver an affordable and more effective alternative to mass transit and taxis for those who cannot afford to buy and own their own car, or for any reason cannot drive themselves. Drivers comprise the major cost for both bus and taxi operators, 75% by some estimates. For bus transport, this translates into fewer, larger buses running on a smaller number of routes. For taxis, this means higher fares. The idea was to use driverless cars to reduce the costs of a ride, not to increase the profits for the fleet operator at the expense of the rider. We needed to test different types of economic and social models to determine which ones work best, initially in Trenton or a place like Trenton. There must be an acceptable level of profit for the operator, so the objective of the test was to find a price-quality of performance level that leads to self-perpetuating operation.

We decided that we needed to present the problem and the proposed solution in a form that could reach everyone, not just politicians or technology investors. We wanted to engage as wide an audience as possible to help build a constituency, both for the evaluation of the concept and for its eventual implementation in other cities and towns in North America and other parts of the world. That is when we agreed to write this book. We would use it as a source to extract content for standalone videos and stand-up presentations to groups to explain the concept to decision-makers, and, most of all, to the people who would benefit from the mobility solutions.

Our major challenge was to remain focused on the users' needs and not to become distracted by the technology. We believe that driverless technology is a means to deliver safe and affordable mobility in situations where a car or a van is the best or only solution. However, what those who need the rides want is a safe and affordable ride, not a high-tech experience. There are many teams around the world that have been vying with each other for almost two decades to be first with a commercially viable, completely driverless car solution. All of them need to be evaluated to determine how well they can solve the safe and affordable equation, but we agreed that we should not be testing technologies or engaging in a technology proof of concept. It should be a proof of

market, to determine if we can create a service that people will want to use because using it will improve their lives. We need to prove that the ride sharing concept with driverless vehicles can deliver the best service for those who are currently not served at an affordable price, and that the price is affordable because the costs are low, not because of high subsidies.

The first two chapters of our book explain why we are concentrating our focus on small vehicles like passenger cars and vans for a mobility solution that will work for those who need a ride. Why not monorails, high-speed trains running in tunnels, bigger buses, or personal jetpacks? Or why not repackage our cities so that everything is within a fifteen-minute walk so that no one needs to get into a car or bus? Chapters one and two attempt to answer these questions. We have a good model for a flexible and affordable mobility concept. Think of a public transport system that has the following features: it runs 24/7; several people can share a ride; they can decide where they will enter or exit the vehicle; it has no driver—although it had one during its early years; it does not make fewer trips during off-peak hours; it is monitored to ensure the safety of the riders; and its invention made something possible that was not possible before. If you guessed 'elevator' and the all-important safety brake, you are right on the money. We believe that driverless vehicles will have as great an impact on making transport flexible and affordable as elevators did on making it possible to build structures that were more than four or five stories high.

The next three chapters attempt to provide an overview of driverless vehicles, including the current state of their operational capabilities. Are they ready to carry passengers? What are their limitations? Can they provide rides everywhere at an affordable price.

Chapter VI, *The Business Proposition of Affordable Mobility*, builds the case for taking what has been promoted as a toy for the rich, a car that lets the driver sleep at the wheel while being chauffeured anywhere, and turns it into a tool for the less fortunate. The innovation is not technology, but the lack of the most expensive component in rides-for-a-fee, namely the driver. Chapters VII, VIII, and IX address the making

and operating of the vehicles, and political, legal, and regulatory aspects of providing an age-old service with a completely new technology. Chapter X, *Making It Happen*, describes the work that has been done in the City of Trenton and the State of New Jersey to prepare for an eventual proof of market.

We have recognized the elephant in the room

Have you ever thought about how we humans have been trying to do more with fewer of us ever since we entered the animal kingdom? Imagine how many of us humans it took to bring down a mastodon before we invented the mastodon trap, or how many we had to be in a tag team to run down a herd of gazelles before we made our first weapons to deliver a deadly blow from a distance. Then there was the fishing net that made it possible for one man to haul in more fish in a morning than a band of waders could catch with their hands in a week. We came up with the idea of sowing seeds of grain to make bread and porridge to tide us over when the hunting and fishing were poor, but we couldn't sow more than we could reap, turning the adage of not being able to reap unless we sow on its head. Our biggest invention was the inventor, and all our inventions have been aimed at one goal: making it possible to do more work with fewer human hands. The side effects have been to be able to do many things at the same time, and to do them faster. To listen to a symphony while driving a car, for example.

When it comes to travel, think about why cars with a single driver, single riders on bicycles and e-scooters pass mostly empty buses, why people who are rich enough travel in private jets and buy their own yachts, and why the isolated cabin on a mountain is an ideal. And all the while we are increasing the number of things we can do with fewer people, the population of the world is increasing even more—and faster. There's no mystery to why we are developing robots. It would be odd if we didn't.

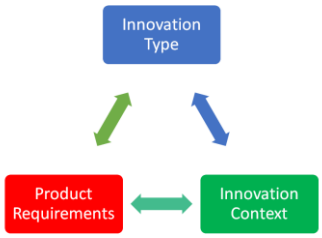
But why are we suggesting that robots replace human drivers to deliver rides to people who are not able to afford a car? Aren't bus and taxi driver jobs an entry point for those who are at the lower end of the economic ladder? The average annual salary for a bus driver with 5-9 years of experience is around $37,000, right at the poverty level in the U.S. for a

family with three children under 18. It is the same for a taxi driver. Wouldn't it be better to have more of those types of jobs, rather than fewer, so that people could afford to buy and operate their own vehicles?

First, it might be better if the cost of the driver was not reflected in the amount of money a transportation operator currently has to pay to subsidize rides. This cost is an average of eight times what the rider pays in most U.S. cities that have transit systems, and still the salaries paid to bus drivers are barely above the poverty level. It is no wonder that services are often the bare minimum—or less. Second, the vehicles that will deliver mobility to those who really need a ride are a supplement to the existing transportation options, not a replacement. It is possible that, in time, more of the motorized land vehicles used for transit will be controlled by driverless systems, and the number of transit driver jobs may be reduced. This will make more of the public transportation system less costly to operate, and therefore allow an improved level of service for more riders.

We need a great leap if we are going to be able to provide mobility for a large portion of the population who need it but who cannot obtain it when they need it for a price they can afford. This book is intended to help us make that leap.

You can find the book at: https://shop.elsevier.com/books/the-real-case-for-driverless-mobility/kornhauser/978-0-443-23685-3



Dispatch Central

The topics covered in Dispatch Central are newsworthy, but I leave it to others to deliver them "as they break". I give them a little time to settle in, and try to provide an analysis of their impact.

Another "Hold Your Horses" dealer letter

CAR DEALERS IN the U.S. haven't heard back from President Biden on their first letter in November, so they have sent another one. The November letter had 4,000 signatures; this one has 5,000. It concerns the same topic as the first, namely, the government's unbridled enthusiasm for battery electric vehicles and the apparent lack of a similar level of enthusiasm by potential car buyers.

The dealers argue that BEVs are "impractical" for many U.S. customers, especially those who live in places where winters are cold. Mickey Anderson, the dealer who is leading this effort, said the following to *AUTOMOTIVE NEWS*: "*The tragedy here is that if the manufacturers were truly free to build the cars that customers today are preferring, we would be selling far more plug-in EVs and hybrids.*"[1]

Of most concern to the dealers is the *ENVIRONMENTAL PROTECTION AGENCY*'s (*EPA*) proposed vehicle emissions "standards"[2] for 2027-32 model-year cars and light trucks. If it passes, it will likely push BEVs to 60% of new vehicle sales by 2030 and 67% by 2032, according to the *EPA*'s own projections. But customers are not ready to switch at that pace, claim the dealers, because of all the "unresolved challenges, such as access to reliable charging networks, affordability, and range anxiety." They also point out that the legislation which has already been passed contains very strict BEV tax credit rules that have significantly reduced eligibility. (These strict eligibility rules were put in there at the urging of Senator Joe Manchin, who felt that the rich were being given a government handout, and that subsidies should

[1] *AUTOMOTIVE NEWS*, January 24, 2024.

[2] I always place the word 'standards' in quotes when referring to emission requirements. There is nothing 'standard' about making a goal a requirement.

help the less wealthy to buy BEVs. It seems that the wealthy liked the handouts more than the cars, and less wealthy don't want BEVs with our without subsidies.)

They ask the President to wait for the battery supply chain to develop outside the control of China, wait for the charging network to be sufficiently built out, and wait until buyers are ready to buy BEVs on their own, without being forced to do so. President Biden's spokesperson has reached out to *AUTOMOTIVE NEWS*, not the dealers, and said that the Inflation Reduction Act does not call for the stoppage of sales of ICE vehicles by a given date, like they have done in Europe. There is no mandate for a specific technology, says the White House spokesperson, and the auto manufacturers can use any technology they want to meet the requirements.

This is bogus, claim the dealers and the manufacturers. There is no other technology which is close to market-ready because all subsidies and government efforts have been directed toward BEVs. The NATIONAL AUTOMOTIVE DEALERS ASSOCIATION has added its voice and said that EPA is moving "too far, too fast". NADA is supporting legislation passed in the House of Representatives last year by 216 Republicans and 5 Democrats that would prevent the EPA from finalizing its proposed vehicle emission "standards".

Will EU back down further on ICE ban?

PORSCHE CFO, Lutz Meschke, was only speculating when he said at the unveiling of the company's *Macan Electric* in Singapore in January, "There's a lot of discussion right now around the end of the combustion engine. I think it could be delayed."[3]

As I wrote in the September issue of *THE DISPATCHER*, in the *Dispatch Central* section under Electrofuels, the EU wanted to ban the sale of all internal combustion engine vehicles within the EU beginning in 2035. Germany, Italy, and France balked. The *EUROPEAN COUNCIL OF MINISTERS* beat back the *EUROPEAN COMMISSION* and forced through the allowance for E-Fuels to be used in new cars sold after 2035. This was all before the sales of battery electric vehicles started to significantly slow down in Europe, North America and in China.

[3] Porsche Exec Says Europe's ICE Ban Could Be Delayed | Carscoops

The UK, which had committed to shut down the sale of new ICE vehicles by 2030, postponed the shutdown by five years, to 2035.

This could just be a way to compel the EU to push countries back into the BEV subsidy business. Much depends on whether the reluctance on the part of consumers to buy BEVs without heavy subsidies is a continuing trend, or whether it is a temporary blip caused by economic uncertainty. We shall see.

One more thing about subsidies. There was a short clip on our (Swedish) TV news on the 12th of February about the French government program to offer really cheap lease deals for BEVs to anyone who has an annual income of under €15,500 ($16,000). It had budgeted for 20,000 leases at a measly €100-150 per month. The program includes a *Tesla Model Y*, which has an MSRP of €46,000 at the low end. A lease for a car costing that amount would be around €825 per month. What do you think happened? The French authorities received over 50,000 requests for a lease withing a few days, so they halted the program for the rest of the year. It said it would continue with its €5,000-7,000 handouts, which cost it a cool €1 billion last year, but the very next day it cut the handout to $4,000 for the 50% of buyers who are in the "highest income" category. It appears that you need to be fast off the blocks in France. Chinese brands are excluded from both the lease program and the handouts.

Criticisim of Euro-NCAP on ISA

ISA STANDS FOR *Intelligent Speed Assistance*. The lead article in a recent issue of the SWEDISH MOTORING ORGANIZATION's magazine is critical of *Euro-NCAP* for making ISA an essential criteria for obtaining a five-star rating. In the JUNE 2022 issue of *THE DISPATCHER*, I took a critical look at *NCAP*, the *New Car Assessment Programs* that exist all around the world. In the U.S., it is operated by the *NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION*, *NHTSA*. In Europe, *EURO-NCAP* is a voluntary program operated as a non-profit organization owned and run by its members with its headquarters in Leuven, Belgium. What *Euro-NCAP* is doing with ISA is one example of why I am critical of the program.

With ISA being mandatory for all new cars sold within the EU starting in July 2024, you might think this is an odd

criticism. ISA was passed into EU law in July 2022, and will go into effect in July 2024. So, what's the problem with awarding those who have it? Actually, if it's mandatory, why give it any notice at all?

First, it is no secret that ISA as finally passed into EU law is not perfect. There are three problems with it:

1. How does the car know what the speed limit is? Here is what the regulation states: "*The ISA system may rely on various input methods, such as camera observation, map data and machine learning, however, the actual presence of real-world explicit numerical speed limit signs, should always take precedence over any other in-vehicle available information.*"[4] There is no requirement for both maps and cameras, and there is no requirement to have an official database of map speeds obtained from the road authorities. If the system relies only on cameras, there will always be a chance that the sign is covered in snow or has been knocked over. If it relies on map data only, there is always a chance the map data has not been updated after a change in speed limit has been made.
2. The regulation allows multiple options to provide feedback to the driver when they exceed the speed limit: an acoustic warning, a vibrating warning, haptic feedback through the acceleration pedal, and speed control in speed is which "*automatically gently reduced*", according to wording in the Regulation. However, the driver can override the system by pressing the accelerator. Drivers do override the system, either because the information is incorrect, or they simply don't want to follow the recommendation.
3. The system can be turned off by the driver. According to the Regulation: "*It should be possible to switch off intelligent speed assistance when a driver experiences false warnings or inappropriate feedback as a result of inclement weather conditions, temporarily conflicting road markings in construction zones, or misleading, defective or missing road signs. Such a switch-off feature should be under the control of the driver. It should allow for intelligent speed assistance to be switched off for as long as necessary and to be easily switched back on by the driver. When the system*

[4] Commission Delegated Regulation (EU) 2021/1958 - https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:2021:409:FULL

is switched off, information about the speed limit may be provided. The system should be always active when switching the ignition on and the driver should always be made aware of whether the system is on or off."[5]

Sweden's motoring organization argues that if the Regulation allows the system to be turned off, *NCAP* has no right to give stars to cars that automatically turn it on every time the ignition is turned on. That constitutes a de facto change to the Regulation, and is creating a dangerous situation for drivers who have determined that the ISA feature is not operating properly in the places where they drive, and who will be distracted from the driving task by constantly having to turn it off.

ISA is good. That is my opinion. The way it has been regulated and implemented in the EU are both bad. And it is enexcusable for *NCAP* to insert itself into the picture frame and elbow itself into the central position with a large, self-satisfied grin on its face.

Letter by another Michael to The Economist

I have written letters to *THE ECONOMIST*, but try as I might, I have not been able to master the trick of getting them published. Michael P. Wells of Gullaug, Norway, wrote the letter I would like to have written, and it appeared in *THE ECONOMIST JANUARY 27TH 2024* issue. It was titled: *It's not just about the car*, and it concerned what I had commented on in my January issue about something *THE ECONOMIST* wrote, which was that we should all be delighted that Chinese BEVs are pouring into the West. Mr. Wells wrote:

"The idea that the West should welcome a huge influx of Chinese electric vehicles is mind boggling ("China's EV onslaught", January 13th). The opening of trade with China in the late 1980s was justified by the expectation that an emerging Chinese middle class would demand democracy and throw off the shackles of the Communist Party. Instead, Chinese affluence driven by Western investment and consumption has facilitated the Chinese government's efforts to centralise power, acquire the West's technologies, build more military capabilities, ruthlessly repress any opposition and build alliances with dictatorships. Far from becoming more democratic and open, China's leadership now represents one of the most severe long-term threats to world security, if not the future

[5] Ibid

of Western civilization. Your argument seems to be that we should increase our trade with China, which would thereby encourage, if not accelerate, these dangerous trends. You identified only one risk to buying EVs from China – competition to Western carmakers – and even then, characterized this risk as "overblown".

If, or or more likely when, China dominates the world militarily and politically a few decades from now, financed by Western consumption, I wonder how astute this view will look. It would be better to ask how does the West stop funding China's march towards global hegemony without suffering politically unacceptable economic costs?"

Thank you, Michael.

Update on strike against Tesla in Sweden

IT CONTINUES, with no indication on the part of the Musketeer that he is willing to negotiate a resolution, and an act of good will from the Swedish. Musk's minions in Sweden have found ways around most of the strike actions taken by the principal union, IF METALL, and the sympathy striking unions, from bringing in non-union workers, picking up their own trash, to hauling their cars from Germany to Sweden with non-union truck drivers, rather than putting them on ships. It is now the longest strike in Sweden since the 1940s, over 100 days, with no end in sight.

Musk's minions in Sweden

On the other side, IF METALL announced on Valentine's Day (also the beginning of Lent) that it would allow the non-TESLA-owned workshops that serve *Tesla* cars and which have a collective bargaining agreement with the Union (there are around thirty of them in Sweden) to fix *Teslas* that have been out of service since the start of the strike. This dispensation will last until the 30th of April. I suppose you could also look at it as a sacrifice on the part of the Union.

Union representatives have said that they see no movement on the part of TESLA to end the strike. Only one out of three TESLA workshop workers are members of the Union, so they are working at two-thirds strength. I believe the only thing that might end it is for Swedish buyers to stop buying *Teslas* and to tell Musk where he can take his company and his cars. Two companies, SKANSKA and ABB, have stopped purchasing Teslas as company cars for employees. They say they are waiting to see how the strike develops.

I was in Göteborg and drove by the TESLA showroom and workshop. Three IF METALL representatives were there, inside their tent shelter trying to stay warm. Their two-hour tour of duty was almost over. They didn't see an end to the strike any time soon. "Musk doesn't understand how important this is for Swedish labor," one of them said. Maybe he does, I thought, but he doesn't care.

Crew Comments

Views on the BEVs being affected by the cold

IN THE BEGINNING of February, when temperatures in major parts of the U.S. and northern Europe were very, very cold, I sent an e-mail to readers. I wrote: *"I thought I would share with you the "expert" tips that were printed in today's national newspaper on getting through a cold winter with a BEV. It advised readers on how to avoid losing up to 50% of the BEV's range: 1) park in a heated garage; 2) charge before you leave the garage, which warms up the battery; 3) don't turn on the car's heater, but use the seat warmer and steering wheel heater and wear extra warm clothes. Actually, only the last one works to add range. I received many interesting comments.* Here are the comments I received.

Anders Fagerholt, formerly in charge of all of ERICSSON's intelligent transportation system activities, sent a video that illustrated his feelings about one BEV model to a T: ICA reklamfilm 2024 v.6 - ICAs egna bröd (youtube.com)

Fredric Callenryd, Senior Portfolio Manager of TRATON (subsidiary of VW of which Fredric's former employer, SCANIA, is now a part) Group Product Management, had a different point of view, and had quite a bit to say in response to my note. He wrote: *"Hmm. Do not share that experience at all with my budget KIA car. Might still be true for a premium Tesla (from a rocket builder) or VW ID.X from a car company trying to do software in a new way.* 😊

"Yes, my Kia loses range when batteries get cold (that is due to chemistry) but maybe 10-15%, and NOT and when starting in a warm garage (0 degrees Celsius). It is less than 10%. Yes, ice and mud add a lot of friction, which means lost energy and higher consumption, adding 10%. That of course is valid for any car with tires, probably as most of the energy in an ICE car is wasted anyhow, which is less obvious.

"All together the range on my KIA in winter Sweden (-10 to –20C) on snowy roads means approximately 20% less range from normal (360 kilometers instead of 400. BUT it is definitely not a cold CAR… I have 7KW of heating capacity for the cabin (that's more than a normal sauna) and if used, it moves from 0 to 22C in the cabin in less than 3 minutes. Keeping that temperature of course takes energy from the battery but hardly noticeable compare

with the friction from ice. In an ICE car all that energy comes from energy wasted anyhow, so that is a difference…

"Charging cold batteries is tricky. My Christmas travelling, with DC charging in -5C, was not superfast, and temperature was probably part of it. The other part was probably from a clogged grid with 20 cars, my car at 50 KW, others higher between 1-2 MW consumed at that location. Charging was somewhat of a struggle, mainly from the crowded roads on peak-travelling day and lack of chargers. The empty Tesla Supercharger in Oskarshamn gave me full capacity later in the evening with slightly cold temperature.

"But all in all, I would say KIA e-Niro 2020 64 KWh is a fantastic car, you get more range at 20C (more than promised) but not bad in winter and definitely not cold inside!"

Maynard Thomson, lawyer, author, world traveler, and avid reader of THE DISPATCHER, wrote: *"Adds to our desire for a fully electric car. Rather depend on a golf cart."*

Graeme Smith, Ph.D. was the founding CEO of OXBOTICA, a spin-out from OXFORD UNIVERSITY specializing in mobile autonomy. He wrote: *"Thanks Mike. Very timely. Even over here in the UK, my Ford Mach E is down from its claimed 319-mile range to 177 miles this morning. (It's -5C, so fairly cold for here!).*

"I think you're starting to see the tip of the iceberg now of why EV's will become a huge political hot potato, with much disinformation. Factors like range reduction in cold weather will bring more owners to public chargers more often, which in cold weather is never going to be welcome. And then the cars will get much more often into the charge zones 0-20% or 80-100% of charge where the charging is throttled (at different rates per manufacturer) while customers must sit and wait and watch and wonder. The variation in range, charge speed and pricing are incredibly confusing and frustrating to most people and causes a rethink of which journeys are suddenly no longer viable or affordable.

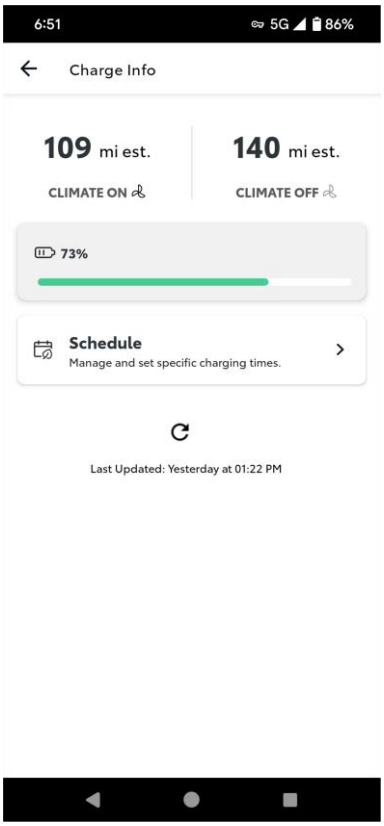
"Over here, most people that buy EV's can charge them at home, but as penetration increases, there will be more folks that need public chargers because they don't have a driveway or garage. Couple this with the factors above plus the low installation rate of chargers here, plus the extortionate price of public charging and then multiply it by the government of the day forcing EV's on the population is going to lead to a lot of political issues. I can see hybrid

solutions being rapidly introduced in many places as government backtracks.

I still like the logic of hybrids and wish I'd bought one. Just doesn't make sense to burn fossil fuels in one place to convert that energy inefficiently to electricity, to route electricity inefficiently over long distances to be stored inefficiently in a battery that translates it inefficiently to motion and power. I'm sure most folks would prefer a hybrid solution in their car and a hybrid fueling solution, so that they can charge cheaply at home. And I'm sure governments will suddenly realise that they can't generate enough electricity for all vehicle to be BEV's or route it around the country at some point too!

Drew Lidkea, Director, Client Relations, ASSISTANCE SERVICES GROUP in London, Ontario, Canada. He wrote: *"Completely same sentiment going around here in Canada, Michael! Out west it has been consistently -40C and people are calling us freaking out they have such little range, charge ports freezing, etc. etc. Power grid issues have led to some people finally asking the inevitable questions about how we (the consumer) can be pushed to EV so quickly when the infrastructure is just not close to being ready. Stay warm!"*

Glenn Mercer has been an independent automotive adviser since 2006 advising investment firms and organizations in the automotive industry. His experience in automotive started 35 years ago when he was a partner in the MCKINSEY AUTOMOTIVE PRACTICE. He wrote: *"Attached is a screenshot of my Subaru Solterra state of charge reading today. It is about 25F here but probably a bit warmer in the garage, so assume 0C. At least SUBARU is candid in showing the range with and without HVAC on. But it is variations like this that drive many EV owners and shoppers nuts. Further, also note that at 73% charge, a range of 191 miles is implied at 100%. But in the summer the car charges to its rated 238 miles at 100%. And in some cases, beyond that. It's like my "gas tank" shrinks in the winter."*



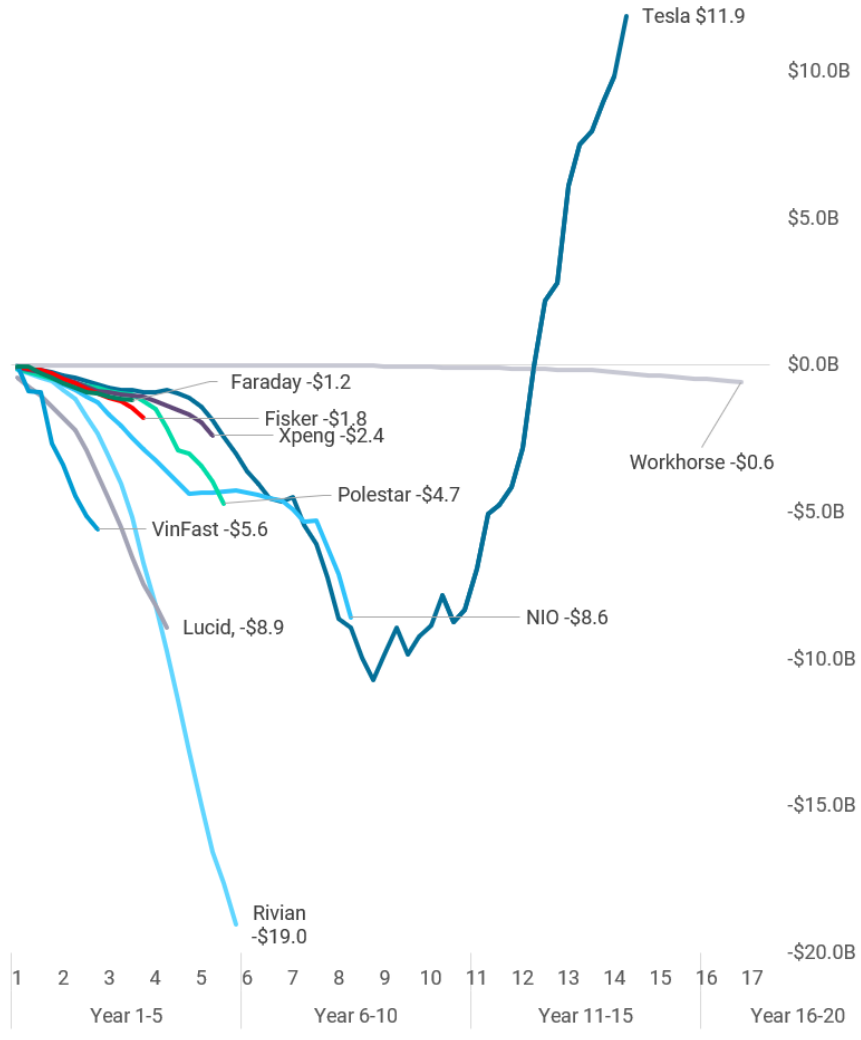
View on the lack of profitability among BEV producers

Jesse H. Ausubel is the Director of the Program for the Human Environment and Senior Research Associate at the Rockefeller University in New York City. He wrote: "…does not make me want to invest in EVs." He sent the image on the next page, sourced from AJ @alojoh from company filings (21 February 2024).

- **The path to generating positive free cash flows is an extremely long and difficult one!**
- **Many EV makers will never achieve this milestone.**
- **Thus far, Tesla is the only pure EV maker which not only delivers consistently positive cash flows but generated cumulative lifetime positive free cash flows.**
- **At present, it is not clear whether a second BEV player can follow in Tesla's footsteps.**

Free Cash Flow History of Pure EV Makers

Cumulative quarterly since inception (US$ billion).



By AJ @alojoh • Source: Company filings • 22-Feb-2024.

Musings of a Dispatcher: Alternative Fuels

Feathered dinosaur Zhenyuanlong from Jinzhou, China, is one of many recently discovered fossils that document how birds arose from their terrestrial ancestors to conquer the skies. Source: From "A Large, Short-Armed, Winged Dromaesaurid (Dinosauria: Theropoda) from The Early Cretaceous of China and Its Implications for Feather Evolution," by Junchang Lü and Stephen L. Brusatte, in Scientific Reports, Vol. 5, Article No. 11775; July 16, 2015

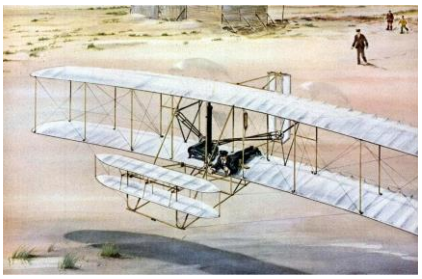
What else can we put into our tanks

HUMANS ARE A resourceful and inventive lot, don't you think? Rather than taking 80 million years to develop the ability to fly like the first flying raptors did, who split off from dinosaurs, their common ancestor, *Homo sapiens* invented a machine that could fly in a mere 300,000 years from the time we first appeared on the Planet. Like the early raptors, humans experimented with flapping, fluttering, and gliding methods before we—not the raptors—settled on the need for a motor to spin a propeller that moved the "airplane" which in turn moved air over the vehicle's wings, lifted it off the Earth's surface, and kept it up there until it either ran out of fuel or was guided by its pilot back down to terra firma. Amazing.

It sounds so simple and common sensical in retrospect, but the airplane wasn't invented in one fell swoop (to borrow a phrase from Shakespeare's Macbeth, of a kite (a type of raptor) taking a farmer's chickens in one swift descent). The structure of the first airplane (by definition, mechanically powered), the Wright brothers' *Wright Flyer*, could have been built when its wing material, muslin, was invented, probably in the first century A.D. in India. The struts and wing ribs were of wood, ash and spruce, which did not need to be invented. But the plane needed an engine that was light enough to fly but heavy enough to deliver the needed thrust. The engine needed a fuel, which the brothers decided had to be gasoline. And to move the air over the wings required a propeller. Those three components were not ready until the early and late 19th century.

It was in 1899 that first Wilbur and then Orville Wright began working on their design for a flying machine. They decided that it was control of the machine, which was the problem that needed solving, believing that the other two parts, the wings and the engine, were basically solved, and that the propeller would simply be a matter of adapting the propeller designed for ship motors. This was far from what they found during the four

years that it took to successfully fly their plane, but they did break totally new ground with their control system, which they patented.



The Wright Flyer, the world's first practical fixed-wing aircraft, self-propelled and piloted.

If oil hadn't been 'discovered', we'd still be earth-bound

On the 11th of June 1895, the first U.S. patent for a gasoline-powered automobile was issued to Charles Duryea. Gasoline was first found to be useful in 1892, although it was produced as a by-product of oil which was distilled to produce kerosene for lighting. It was Edwin Drake who dug the first oil well in Pennsylvania in 1859. The *Benz Patent-Motorwagen*, which was built in 1885 by Karl Benz and regarded as the first "practical modern automobile", ran on 'ligroin fuel', a petroleum product also called heavy 'naphtha'.

Orville and Wilbur knew they would have to use gasoline. They calculated that their engine had to produce at least 8 horsepower and weigh no more than 200 pounds. No such engine existed among the hundreds of companies producing cars and trucks at the time. They determined that the engine had to be aluminum for lightness. Both Benz and Gottlieb Daimler were making aluminum engines, so there was precedent. The final engine was 180 pounds and developed 12 horsepower at 1,025 revolutions per minute (RPM). "The fuel system had a one-gallon fuel tank suspended from a wing strut, and the gasoline was fed down to the engine in a tube to the engine. There was no carburetor. The fuel was fed into a shallow chamber in the manifold, the raw gas blended with air, and the engine was started by priming each cylinder with a few drops of raw gasoline."[6]

There were no spark plugs. The spark to ignite the gasoline and air mixture was made by the opening and closing of two contact points inside the combustion chamber. The ignition switch was an ordinary single-throw knife switch which the engine builder, Charlie Taylor, bought at a local hardware store. There was no battery on the plane. Dry batteries on the ground were used for starting the engine and then the electrical duties were handed over to a magneto that Charlie bought from the DAYTON ELECTRIC COMPANY. This was all at a time when most of the cars being sold were electric, and

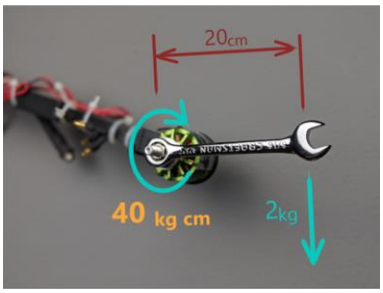
[6] https://wright-brothers.org/Information_Desk/Just_the_Facts/Engines_&_Props/1903_Engine.htm

the primary transportation conveyances, locomotives and water-going vessels, were powered by steam engines. There had been tests made of unmanned flying devices powered by steam, but there do not seem to have been any electric flying machines. Batteries were just too heavy at the time. Gasoline as the fuel for the *Wright Flyer*, the first crewed airplane, was fit for purpose.

Diesels use diesel fuel

Rudolf Diesel gave his name to his invention, the diesel engine, and to the fuel that is burned in his engine, diesel fuel. He was born in Paris of Bavarian parents, studied at the ROYAL BAVARIAN POLYTECHNIC OF MUNICH, and worked in Germany. His major work focused on designing an internal combustion engine that could approach the maximum theoretical thermal efficiency of the Carno cycle.[7] His work led to what is called the 'diesel engine' in which fuel is injected at the end of the compression stroke and is ignited by the high temperature that results from the compression. This is in contrast to gasoline engines in which spark plugs are used to ignite a mixture of air and fuel in the cylinder. The first successful test of his diesel engine was in 1897.

Gasoline and diesel engines are both internal combustion engines. Diesel wanted to develop an engine that used fuel more efficiently than gasoline engines. He achieved this with the engine design and with the higher energy density of diesel fuel. The result is more energy is extracted with the diesel engine and diesel fuel for every gallon/liter of fuel that is used. Diesel engines generate more torque, which is the force that causes objects to rotate (see sidebar). With vehicles, more torque means faster acceleration. Diesel engines are also better for engines that require heavy lifting or towing, which is why they became the choice for ships, locomotives, trucks, and digging equipment, replacing steam during the beginning of the 20th century. Diesel engines have also proven to be more durable.



An example of torque is seen when you use a wrench to affix a nut. If you have a wrench that is 20 cm long, and you push down on the wrench with 2 kg of force, the torque on the nut is (20 cm x 2 kg =) 40 kg·cm.
(Source: https://maker.pro/custom/tutorial/what-is-torque-and-why-does-it-matter)

It is stated in most sources writing about Rudolf Diesel that diesel fuel originated from the experiments he conducted to

[7] Sadi Carnot's theorem provides an upper limit on the efficiency of any classical thermodynamic engine during the conversion of heat into work, or conversely, the efficiency of a refrigeration system in creating a temperature difference through the application of work to the system.

build his engine. However, he claimed in a working paper, Theory and Construction of a Rational Heat Motor (Springer, 1893), that "*the engine would work with any kind of fuel in any state of matter*". However, he only tested liquid fuels, including crude oil, gasoline, kerosene (paraffin), lamp oil, coal tar creosote, fuel oil, shale oil, and peanut oil. 'Diesel fuel' is defined as "any liquid fuel specifically designed for use in a diesel engine", but there is no single specification for that liquid. What we might think of as the common type of diesel fuel, what we pump into our cars and trucks, is a specific distillate of petroleum fuel oil. It was standardized in the 1930s. The *AMERICAN SOCIETY OF TESTING AND MATERIALS* established seven grades of diesel fuel.[8] Other distillates of petroleum fuel oil include heavy fuel oil, marine fuel oil, furnace oil, gasoil, heating oils, among others. These are all heavier than gasoline and naphtha.

What would happen if there were no petroleum?

During the late 1930s, around the time that cars, trucks, heavy equipment vehicles, ships, and locomotives began to be used in great numbers, governments all around the world decided to go to war. It was the second of the two World Wars that really put a damper on the non-military uses of petroleum, which were rationed in those countries like the U.S. that had its own petroleum resources, while most of the world's supplies were fueling war planes, tanks, and troop carriers on land, sea, and air. In countries which did not have their own oil wells or that were at the far end of the refined oil supply chain, they either had to do without vehicles altogether or find another fuel alternative. One of those countries was Sweden.

Carl F. Magnusson was a successful owner of a transportation company in Stockholm before the Second World War. He had both a trucking and a taxi business. One of his employees was a young man named Hilding F. Borg, who drove both trucks and taxis for C.F. Magnusson. Hilding married one of Carl and Hilda Magnusson's daughters, whose name was Sonja. Sonja and Hilding had two children, a son born in 1947 and a daughter born in 1950. The daughter's maiden name was Britt Marie Christina Borg, who is my wife of forty years. Britt Marie says that she never saw

[8] https://archive.org/details/gov.law.astm.e29.2002

the taxis that her father drove during the war years, but she heard stories about them. They were called 'gasifiers' like the one in the sidebar to the right.

Driving on wood[9]

There are some good lessons we can learn from understanding how Sweden was able to keep around 10% of its passenger cars, much of its commercial fleet of trucks, and a good portion of its farm vehicles operating during the Second World War when its supply of petroleum-based fuels was all but cut off except for military uses.

An example of a gasifieir, a gasoline-driven car converted to run on wood or charcoal.
Source: https://wonderfulengineering.com/during-world-war-due-to-non-availability-of-fuel-these-cars-were-converted-to-run-on-wood/

Like all industrialized countries in the early-to-mid 20th century, Sweden was very dependent on coal to meet its energy needs. By 1914, imported coal met one-half of its total energy demands. At the same time, 70% of Sweden's electricity was generated with hydropower stations, and 90% of that electricity was used for manufacturing purposes. It was from the rivers in the southern one-third of the country, where more than two-thirds of the people lived and where Sweden's industries were located, where hydropower came from. It would be several decades before electricity use expanded beyond Sweden's factories, and it would take a technological breakthrough to supply the energy for producing more electricity from the vast resource of big rivers in the northern part of the country. I will return to this later on.

A small hydropower station in the south of Sweden.
Source: Swedish Agency for Marine and Water Management

When the First World War broke out and German U-boats began to sink freight and passenger ships alike, Sweden's coal imports were drastically reduced. In 1917, the Swedish government established a *FUEL COMMISSION* and gave it the responsibility for planning and managing the country's fuel supply. The *COMMISSION* focused on the country's largest domestic fuel source at the time: wood. (Approximately 70% of Sweden's total land area is covered by forest. Sweden is the third largest country in land area among the Western European countries, so think of Italy covered by nothing but forest.) The *FUEL COMMISSION*'s work was guided by another government commission which had performed an

[9] All of this section is based on a paper written by Arne Kaijser, Driving on wood: the Swedish transition to wood gas during World War Two, Routledge, History and Technology – 2021, Vol. 37, No. 4, 468-486. (https://www.tandfonline.com/doi/full/10.1080/07341512.2022.2033387)

assessment of the country's energy supply in 1915, including peat, coal, shale oil, and wood, as well as studying the total potential for hydropower. In 1919, the *SWEDISH ACADEMY OF ENGINEERING SCIENCES* (*IVA – INGENJÖRSVETENSKAPSAKADEMIEN*) was formally established, devoted to both energy research and technical research in general, and directed to build on the findings of the two commissions, securing Sweden's independent energy future.

The First World War ended, and deliveries of coal and petroleum resumed, but *IVA* continued to look for ways to reduce Sweden's dependency on imported fuels. 'Automobilism', (or *bilism* as it is called in Swedish) quickly expanded. There were fewer than 5,000 motorized vehicles in Sweden before 1914. By 1939, there were 63,000 trucks, 5,000 buses, and 180,000 passenger cars. Five global oil companies, STANDARD OIL, SHELL, TEXACO (pronounced TEX-AH'-COH), BP, and GULF, set up business operations in Sweden, and by 1939 they had built 12,000 fuel stations in the country.

In the 1920s, *IVA* understood very well that fueling the country's vehicles would be an existential problem if something happened, like another war, to cut off supplies of oil, both refined and unrefined. It began serious investigations of using sulphite ethanol based on wood. This met loud criticism from the very powerful alcohol prohibition lobby which feared it would provide a new source of the intoxicating product at a time when prohibitionist politicians were introducing legislation to ban alcohol altogether. *IVA* also conducted research in hydrogenation, that is, producing oil products out of wood. It established the *Coaling Laboratory*, and in 1930 built a pilot plant based on the invention of the German engineer Friedrich Bergius' method of hydrogenation of wood, peat, charcoal and tar. It worked, but it was costly and complicated.

And the winner was Gasification

A third option, 'gasification', gradually gained most of the researchers' attention. It is known as *gengas* in Swedish, a shortening of 'generator gas'. This method used either charcoal or wood to produce a gas comprised of one-third combustible gases, principally carbon monoxide, and two-thirds of non-combustible gases, principally nitrogen. The method was not new. It had been developed in the 19th century for

fueling stationary engines. Small gasifiers were first produced in France in the early 1920s and adapted for use in motor vehicles. After the gas was cleaned and cooled, it could be pumped into a car with an engine built for kerosene. An industry developed in Sweden in the 1920s for building gasifiers for stationary engines, but it died out by the end of the decade. It was revived during the global economic downturn in the 1930s when the Swedish forestry industry lost its export market for lumber products, resulting in mass unemployment. The industry proposed that motor vehicles in Sweden should be converted to run on wood and charcoal, and the Swedish Parliament complied.

In 1932, the Swedish Parliament set up a loan fund of 200,000 SEK (around 6 million SEK, or $570,000 today) so that vehicle owners could borrow money at affordable rates to purchase and install a gasifier. It also decided to reduce the vehicle license duty for vehicles with gasifiers. (Yes, it set a precedent for a policy it instituted eight decades later to subsidize the purchase of battery electric vehicles and favor BEVs over ice by charging an annual tax ten times higher for ICE vehicles.) A total of 250 orders were placed for gasifiers. The government increased the loan fund to 750,000 SEK (22.5 million SEK, or $2 million, in 2015), but only four more orders were made. The experience of those first 250 converts soured the market. "They complained about lower motor power, lack of operational reliability, difficulties in buying appropriate charcoal, and how troublesome, filthy and tedious wood gas was compared to petrol."[10] Everyone went back to gasoline for cars and diesel for heavy equipment, but *IVA* felt they had a backup solution in case the country needed it.

Plan B was swiftly put into effect

Six days after Germany invaded Poland on the 1st of September 1939, the *WOOD GAS BOARD* was established by the Swedish Parliament and given the task to introduce gasification into Sweden as quickly as was physically possible. Oil imports were reduced to a trickle in April 1940 with the German occupation of Denmark and Norway, and what oil that did arrive at Sweden's ports was allocated to the military. The *WOOD GAS BOARD* was ready to quickly spring into

[10] Kaijser, op. cit.

action because the people running it were the same people who had set up *IVA*. The first step they took was to establish an education and training program for drivers, and a certification program for the fitters of the systems. Previous experience with gasifiers had shown that there was a high risk of fires and gas poisoning if the equipment was not installed properly. Drivers had to be trained to adapt their driving methods to the different performance standards of engines fueled by gas. (Contrast this with the total lack of driver training today to adapt their driving methods to battery electric vehicles.)

There were proposals to nationalize production of gasifiers, but these were seen off. By the end of the War, there were 150 companies making 500 different types of gasifiers. What the government did nationalize was the buying, production, and selling of the fuel for the gasifiers, wood and charcoal, ostensibly to ensure that the prices were fair at every stage in the delivery chain.[11] A total of 750 stations for selling the wood and charcoal were created, quite a reduction from the 12,000 private fuel stations where gasoline was sold, but given that buyers could come to the station with a trailer and store the fuel at home, it seemed to be sufficient. At first, charcoal dominated. It was quicker to start and easier to handle. But as the drivers gained experience, they learned that wood was more economical and could deliver a range 2.5 times longer than charcoal. Compared to filling the car's tank with gasoline, driving on wood or charcoal required a great deal of extra work and inconvenience. The wood or charcoal had to loaded into the car's firebox. It took at least fifteen minutes before there was enough gas to start driving. The box had to be reloaded after around two hours of driving, just like a wood stove needs to be replenished regularly. In fact, it was like towing a wood-burning stove behind the car (see sidebar). The engine had to be cleaned regularly to remove the tar build-up, which was both time-consuming and a dirty, messy job. The driver had to be constantly aware of the air-gas mixture so that the engine didn't suddenly stop. And, on top of this, the power coming from the engine

[11] Sweden has a state-controlled wine and spirits market. All wine, liquor, beer and other beverages with alcohol content over 3.5% are sold in state stores called Systembolaget.

was about 50% less than with gasoline and 20% less than with diesel.

By the middle of 1943, there were 75,000 gasifiers in use, of which 20,000 were private car owners. This is quite a reduction from the 180,000 cars in use at the start of the war. Cars that were not converted were unregistered, waiting for the time when they could be brought back into use when oil began to flow back into the country. That happened with a vengeance once the War was over.

Like cows being put out to pasture from the barns in the spring

The *Wood Gas Board* knew that as soon as the War was over, it would be out of business—and it was. Owners of all those unregistered cars ran to the authorities to get them re-registered as quickly as their feet could carry them. The oil companies returned soon after victory in Europe was declared. By the end of 1946, there were only 7,000 gasifiers left, and at the end of 1949 there were only 500 diehards remaining. What happened after the end of the War set the stage for Sweden's next energy transformation, and it was also due to Swedes' appetite for automobilism.

In 1970, there were almost 2 million cars registered to drive on Sweden's roads. Oil accounted for 75% of Sweden's total energy demand, while coal was still a substantial source for electric energy, representing 30%. The *Swedish State Power Board*, which had been established in 1909 and was responsible for seeing to it that sufficient electricity was produced to meet the country's demands, decided that it needed to expand hydropower and find another source of energy in order to eliminate the country's use of coal. The technological breakthrough I mentioned earlier that was needed was a way to move electricity produced in the northern two-thirds of the country, where there was substantially more potential for hydropower from the country's biggest rivers. This came in 1952 from the global electrical equipment manufacturer, ASEA (now ABB), in the form of the first 400-kV transmission lines that could carry power from Lappland in the north to the southern tip of Sweden. In the 1950s and 1960s, hydropower generation tripled, and prices plummeted.

Sweden wasn't finished. The *Power Board* reckoned that if electricity demand continued to grow at its then-current pace, all of the country's hydropower would not be sufficient

to meet the needs of industry and households. The consensus was that Sweden needed to develop nuclear power. In 1956, the Swedish Parliament adopted a policy to use domestic nuclear fuel. It had been discovered in the 1940s that Sweden had the largest uranium deposits in Europe. Between 1965 and 1985, Sweden built twelve reactors producing the equivalent amount of electricity as all of the hydropower stations in the entire country. Coal disappeared completely, and a few back-up oil-fired power stations were all that remained from the days of carbon-based energy production in Sweden.

Then the party poopers arrived

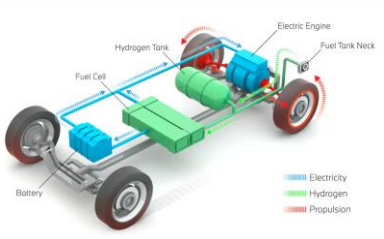
Environmental concerns put the kibosh on the further exploitation of hydropower and the entire future of nuclear power. In 1972, the Swedish Parliament decided not to build any more dams on the country's rivers due to the effect they had on salmon and sea run trout migration, as well as for other environmental reasons. At the same time, the global anti-nuclear lobby was growing, and this led to a referendum in the Swedish Parliament in 1980 on the future of nuclear power. The Parliament decided to continue expansion of nuclear power, but at the same time, it decided that all nuclear powerplants would close by 2010. The closing date was later postponed, but today only 6 of the original 12 are in operation. They would all be gone by now if it had not been for the increased need for electricity, the realization that solar and wind are an unreliable replacements, the European energy crisis caused by Russia's brutal and totally illegal invasion of its neighbor, Ukraine, and the impact that has had on oil and gas suppliers. At present, the Swedish government is re-evaluating nuclear power. No more nuclear power stations will be closed for the time being, and studies are being conducted to determine if new nuclear power can be added using the latest technologies. The two parties that pushed hardest for abandoning nuclear power are now holding on to their seats in parliament by their fingernails after voters have understood they have been responsible for leading the country down an energy rabbit hole.

As soon as we think we have the answer, we're lost

Right now, most governments are trying to decide whether to build their future energy policies around electricity generated by solar and wind power, so-called renewables, in

order to eliminate our dependence on fossil fuels. Human history has been formed by two goals: finding ways of doing things with fewer hands; and finding ways to generate the energy needed to accomplish the first goal. If the problem we are trying to control is that the weather is out of control, isn't it odd that we are creating a dependence on two important components of the weather: the sun continuing to shine and the wind continuing to blow? And then we take it one step further. We allow a single country to gain a near monopoly on manufacturing the equipment needed to turn the sun and wind into energy sources, solar panels[12] and wind turbines, as well as batteries and the equipment that use the energy. As the Sweden example of energy planning shows—and it is only one example among many—we need Plan Bs, Cs, and Ds.

Luckily for humankind, research has continued developing those plans, in spite of governments trying to force us into a single path to heaven, and in spite of hysterical climate activists telling the politicians that only they have the right to say which path that is. Synthetic fuels, hydrogen fuel cells, fusion, and who knows what else, all must be part of our constant search for the best mix of energy sources. We have work to do. Let's get on with it.

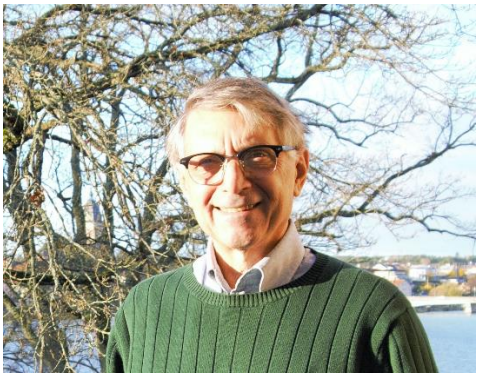


[12] 95% of all solar panels installed in the EU are coming from China. They are undercutting the remaining European producers, who are all on the brink of failure. By 2030, the area within the EU covered by solar panels is projected to be twenty-five times the size of Paris, or 74% of the total area of France.

About Michael L. Sena

Through my writing, speaking and client work, I have attempted to bring clarity to an often opaque world of highly automated and connected vehicles. I have not just studied the technologies and analyzed the services. I have developed and implemented them and have worked to shape visions and followed through to delivering them. What drives me—why do what I do—is my desire to move the industry forward: to see accident statistics fall because of safety improvements related to advanced driver assistance systems; to see congestion on all roads reduced because of better traffic information and improved route selection; to see global emissions from transport eliminated because of designing the most fuel efficient vehicles.

This newsletter touches on the principal themes of the industry, highlighting what, how, and why developments are occurring so that you can develop your own strategies for the future. Most importantly, I put vehicles into their context. It's not just roads; it's communities, large and small. Vehicles are tools, and people use these tools to make their lives and the lives of their family members easier, more enjoyable and safer. Businesses and services use these tools to deliver what people need. Transport is intertwined with the environment in which it operates, and the two must be developed in concert.



Michael L. Sena

Editor

SUNDBYVÄGEN 38

SE-64551 STRÄNGNÄS

SWEDEN

PHONE: +46 733 961 341

E-MAIL: ml.sena@mlscab.se

www.michaellsena.com