

Conversion of the TCAT Bus Fleet to Electric Vehicle Mobility An Exercise in True Sustainability and True Environmental Protection

Preamble

The Tompkins County Area Transport (TCAT) is an independent organization that provides public transport, concentrated in a region of New York State called the Finger Lakes. The service areas are routed around the second largest of the Finger Lakes, Cayuga Lake. ^A

This unique geography dictates much of the TCAT burden: (1) circuitous routes *per se*, (2) mountainous/hilly terrain, (3) both open rural and tight city routing, and (4) four distinct weather seasons, with winter being especially demanding (ATTACHMENT 1).

These factors are especially attractive as both pilot and prove-out of the concepts of electric vehicle (EV) mobility. In other words, if the EV is viable in this challenging Tompkins County setting, than it should be viable in the less demanding scenarios (ATTACHMENT 2).

Context – Part 1 of 3 : The Natural Beauty of the Finger Lakes Region

The Context of the subject-related Proposal is three-fold.

The beauty of the Finger Lakes Region is not a matter of personal opinion, it is world-renown. The landscapes are as rugged as they are appealing to human and wildlife alike. When I share photographs of the area, including from the campuses of Ithaca College and Cornell University, many, especially those who have never visited are skeptical that the photos are “New York.”

Any proposals that involve (or allege to involve) protection of the environment must ensure that goal comprehensively. Proverbially, two steps forward and one back is not acceptable. Nor does trendy rhetoric constitute or justify alleged “compromises.” From ATTACHMENT 1:

Ithaca is home to two major academic institutions, making the population especially sensitive to the human condition, and how preservation of the environment is central to their well-being. That preservation however is intimately tied to ensuring that so-called solutions to environmental issues do not impinge in any way on the famous beauty of the Finger Lakes region.

Specifically, the notion that conversion of the TCAT bus fleet to full EVs, and that the additional power can only be accommodated by spattering the Finger Lakes with the eye sores of solar panels and wind farms is rejected.

An alternative solution to the ‘increased EV power demands’ is proposed that is (1) far less destructive to the Finger Lakes environment especially its myriad wildlife, (2) far more technically robust (i.e. efficient especially in terms of spatial footprint), (3) orders of magnitude more reliable (i.e. predictable support of grid base load), and (4) far more forward-looking in terms of a future wherein, not only will the EV dominate most/all transportation needs, but the elimination of hydrocarbon/ carbon sources of power can be eliminated for non-transportation needs; home heating and power, etc. (ATTACHMENT 3).

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Context – Part 2 of 3 : A Lack of Local Focus on the EV Solution

Examples of municipalities that have converted some or all of their buses to EV, or have active plans to do so, abound worldwide. But plans to do so in Tompkins County New York are rife, if existent at all. The numerous official energy studies produced over the last ten years on this region never even mention the term ‘electric bus.’ A few typical examples:

- In the 2012 report, *Energy Supply and Demand - Tompkins County, New York*, the terms bus, TCAT, etc. are nowhere to be found. ^B
- In the 2016 report, *Tompkins County Energy Roadmap*, the only time the TCAT bus is even discussed is in reference to “bus terminals.”

But this only gets worse . . . and this latter report is typical. It never mentions ‘electric bus.’ Instead it makes the claim that bus terminals are “*deemed appropriate*” for medium and large scale wind farms. A screenshot from Page 65: ^C

Lands Deemed Appropriate for Medium-scale Wind:

Many land uses may be acceptable for developing medium-scale wind power. This analysis identified the following tax parcel property classifications as being appropriate for hosting medium-scale wind:

- Agriculture
- Commercial
- Industrial
- Public Services – includes water treatment facilities, bus terminals, pipelines, landfills, electric and gas facilities
- Recreation and Entertainment – includes fairgrounds, racetracks, golf courses, riding stables, camping facilities and picnic grounds
- Vacant Land – includes abandoned agricultural land
- Community Services – includes schools, libraries, colleges, churches, hospitals, government buildings and parking lots, correctional facilities and cemeteries

Dozens of these studies involving Ithaca and Tompkins County New York are instead focused (to the point of ranting) on “fossil fuels” and “carbon footprint.” ^D

Some observations:

- Assuming these two focus items are credible, how to explain avoidance of the obvious two-fold resolution, a full EV TCAT bus fleet eliminates both. There is no reference in these official reports to *Conversion of the TCAT Bus Fleet to Electric Vehicle Mobility*.
- This incompetence/bias is compounded by the diatribe directed at nuclear power. The references to nuclear power are diversionary, dismissive, **and self-contradictory**. The latter borne by the well-known fact that nuclear power does not have a “carbon footprint.”

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Context – Part 3 of 3 : The TCAT EV Bus Conversion as ‘Low hanging fruit’

Very few municipalities in the so-called West are actively pursuing the many advantages of converting their public transport to EV. ^E

A noteworthy exception is the State of California, where favorable promotions, laws and public opinion abound. The Antelope Valley Transit Authority (AVTA), has routes that include the metropolis of Los Angeles. From their website:

January 2018 - The AVTA is bringing a fresh new energy to public transportation in the Antelope Valley! In 2016, the Board of Directors for AVTA set a goal of becoming the nation’s first fully electric fleet by the end of 2018, and plans to convert all of the agency’s aging diesel buses to a 100% battery electric bus fleet with up to 85 new all-electric buses. The board’s decision provided the agency with clear direction and sent a strong message that AVTA is serious about its intent to be “100% Green by 2018.” ^F

Indeed, the ACTA is an exemplar for all to emulate. That AVTA webpage continues:

The electrification of commuter routes will serve as a major pilot program for the State of California as electric commuter coaches are new to the transit industry.



But AVTA is not the only municipality to recognize, and act upon, the many advantages of the ‘low hanging fruit’ that conversion of its bus fleet to full EV represents. Perhaps the most awe inspiring municipality is the City of Shenzhen, China. Reacting in-part to a national edict,

AUTOS BUSINESS

China is banning traditional auto engines. Its aim: electric car domination

LA Times | By RUSS MITCHELL AND JESSICA MEYERS | SEP 12, 2017 | 10:00 AM | BEIJING

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Context – Part 3 of 3 : The TCAT EV Bus Conversion as ‘Low hanging fruit’ - Con’t

the city of Shenzhen converted all of its buses to EV; a staggering feat involving 16,359 units: ^G



Occurring in the same timeframe, the Amsterdam Airport in the Netherlands converted all Schiphol terminal buses to full EV: ^H

These are just a few examples, with many more bus fleet EV conversions in-progress or under dedicated study. ^I Clearly the world at-large agrees that **conversion of municipal bus fleets to full EV constitutes the proverbial ‘low hanging fruit’** ^J

Three-Fold Summary of Context – Basis of Proposal

- A. Any proposals that involve (or allege to involve) protection of the environment must ensure that goal comprehensively. Heretofore avoided in these “discussions,” the beauty and ecology of the Finger Lakes is not to be subjugated to the compromises of alleged “sustainability,” especially when such benefits vested money interests.
- B. The attitudes and lack of **long-term** foresight of local and state level New York officials, regarding energy plans, specifically as such relates to the incremental power demanded by **long-term** vision of electric mobility must be addressed/corrected.
- C. Connected to Context B, the world at-large has already determined that transport bus conversion to full EV constitutes the greatest and quickest comprehensive benefits; the proverbial ‘*low hanging fruit.*’

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Discussion

The conversion of City of Shenzhen’s 16,359 unit bus fleet to EV poses three questions:

1. Does anyone actually believe that China intends to charge the batteries of that fleet (among many more to come) by use of wind farms and/or solar panels?

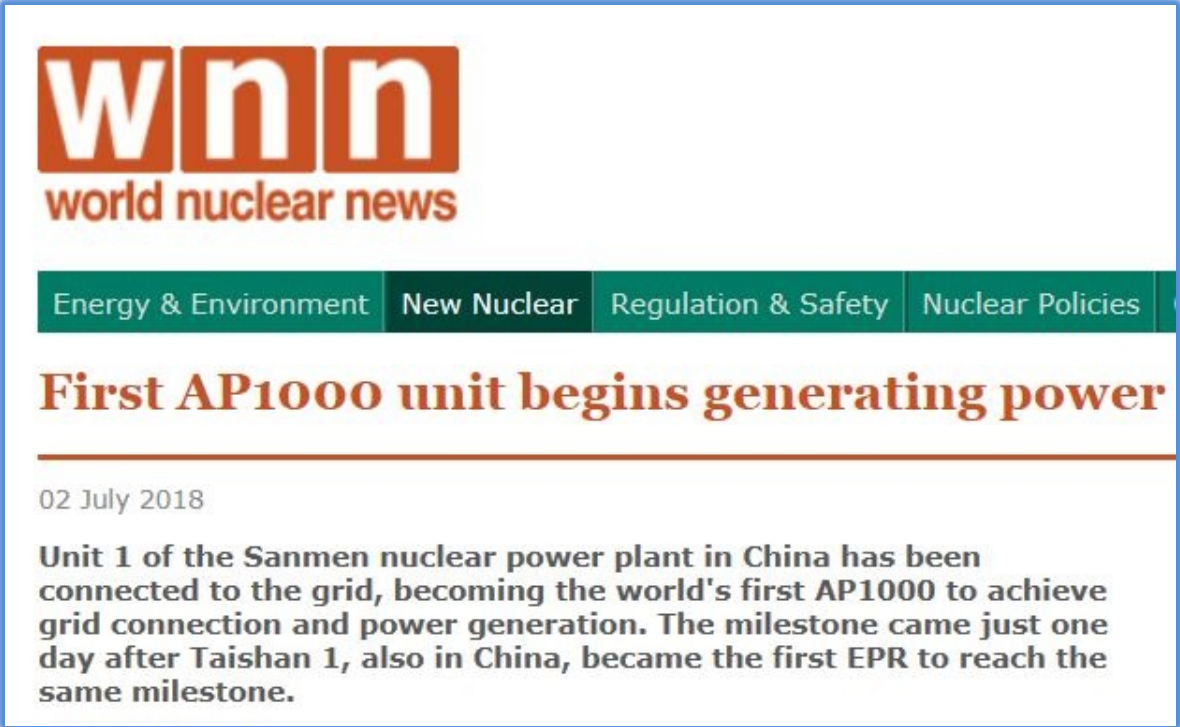
If we assume that most of the 16,359 units are the 40 foot coach model, the K9 Transit Bus, this involves charging its 500 kWh battery. The local charging infrastructure must accommodate an additional 8179500 kW, or **8.2 Gigawatts. An enormous amount of power.**

The Shenzhen infrastructure has been updated with 500-plus charging stations and 8,000 charging poles. The article, ‘China’s Shenzhen City Electrifies all 16,359 of its Public Buses,’ coyly concludes with the following unqualified, unspecified claim : ^K

“ . . . it took around \$490 million in subsidy to get the program started, but that’s a small price to pay for cleaner air, quieter cities and a huge boost to the renewables world.”

What renewables?! Wind ? Solar? Clearly this journalist avoided the above question, and avoided the simple calculation for the power required to routinely charge 16,359 batteries of 500 kWh each! He also avoids the fact that Shenzhen has 12,518 taxis, 62% of the total, which are already EV, the remaining 38% taxi fleet to be converted in 2018.

2. If we assume that China bans the internal combustion engine (ICE), what is their long-term solution to the enormous incremental electrical energy required?



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Discussion – Con't

The EyeShenzhen article of December 28, 2017 discusses how the proverbial low-hanging-fruit in the City of Shenzhen has performed :

“ The electric buses use 72.9 percent less energy than diesel buses. In a year, the buses could save the energy equivalent of 366,000 tons of standard coal, replacing 345,000 tons of fuel, and reducing carbon dioxide emissions by 1.35 million tons. ”^L

Nuclear Power in China

(Updated July 2018)

- Mainland China has over 40 nuclear power reactors in operation, about 20 under construction, and more about to start construction.
- The government's long-term target, as outlined in its *Energy Development Strategy Action Plan 2014-2020*, is for 58 GWe capacity by 2020, with 30 GWe more under construction.
- The impetus for nuclear power in China is increasingly due to air pollution from coal-fired plants.
- China's policy is to have a closed nuclear fuel cycle.
- China has become largely self-sufficient in reactor design and construction, as well as other aspects of the fuel cycle, but is making full use of western technology while adapting and improving it.
- Relative to the rest of the world, a major strength is the nuclear supply chain.
- China's policy is to 'go global' with exporting nuclear technology including heavy components in the supply chain.

Most of mainland China's electricity is produced from fossil fuels, predominantly from coal – 73% in 2015. Two large hydro projects are recent additions: Three Gorges of 18.2 GWe and Yellow River of 15.8 GWe. Wind capacity in 2016 was 9.1% of the total installed generating capacity, but delivering only 4% of the electricity.

China's commitment to a fleet of modern sustainable nuclear power plants, and its commitment to banning the internal combustion engine, are inextricably connected: The former allows the latter to become a practical feasible reality. **These commitments resolve the pollution issues at both ends of the well-to-wheel life cycle:**

- A. At the well . . . the West in particular, continues to fumble with the notion of “carbon capture,” or “carbon sequestration.”

Globally these schemes involve trillions, not billions, **but TRILLIONS** in retrofit investment capital. The focus is the coal fired power plant. Nuclear power plants require no such schemes, and the associated squandering of precious retrofit capital.^M

- B. At the wheel . . . the low-hanging-fruit, conversion EV eliminates from the transportation fleet the two primary issues: Chemical and noise pollution.
(please see ‘The TCAT Bus Fleet – Background Brief’ below.)

3. Would it not be prudent to emulate the China approach wherein capital that would otherwise be squandered in the retrofit of coal fired power plants is instead deployed to the construction of modern highly reliable nuclear power?^N

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Discussion – Conclusion

The author attended the Society of Automotive Engineers (SAE) Electric Vehicle Symposium in February 2018, held in San Diego, California. Mr. Xingyi Xu, from China’s Shanghai Dajun Technologies group presented the following slide: ^o

China Is Leading EV Development in the World

Huge total market with a large variety of segments

- Car-sharing in large cities vs. personal cars in the countryside;
- Light duty commercial vehicles with various specialties;
- Heavy duty E-trucks; etc.

Worldwide NEV Sales in 2017			
Ranking	Country	Total sales	Proportion
1	China	463369	53.70%
2	Japan	107740	12.49%
3	USA	104487	12.11%
4	Norway	33439	3.88%
5	France	32305	3.74%
6	Germany	27583	3.20%
7	England	22141	2.57%
8	Korea	13541	1.57%
9	Holland	8771	1.02%
10	Canada	8057	0.93%

Source: Marklines

Year	Charging pile	NEV	Proportion
2010	~100,000	~100,000	51%
2011	~200,000	~100,000	103%
2012	~400,000	~100,000	135%
2013	~500,000	~100,000	101%
2014	~100,000	~100,000	30%
2015	~100,000	~100,000	13%
2016	~100,000	~100,000	28%
2017	~100,000	~100,000	26%

Source: Perspective research institute

The right panel establishes that China is not merely the leader in deployment of EVs, but that **China’s domination represents more than the next nine countries COMBINED.**

A survey by Delft University of Technology showed:

Poll Question

[Bookmark this page](#)

POLL QUESTION 1
Do you think all major cities across the world should have zero emission electric city buses by 2030?

RESULTS

<input checked="" type="radio"/>	Yes	90%
<input type="radio"/>	No	10%

Results gathered from 676 respondents.

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The Tompkins County Area Transport (TCAT) Bus Fleet – Background Brief



From the TCAT website: ^P
“ At present, TCAT has a fleet of 54 buses, including eight electric-diesel hybrid buses, traveling a combined distance of 1.6 million miles a year. Recent replacement buses include two new electric-hybrid and 13 new diesel buses that adhere to federal standards in producing fewer carbon emissions.”

During the steep uphill routes, the diesel engine is the primary propulsion source, resulting in both chemical and noise pollution.

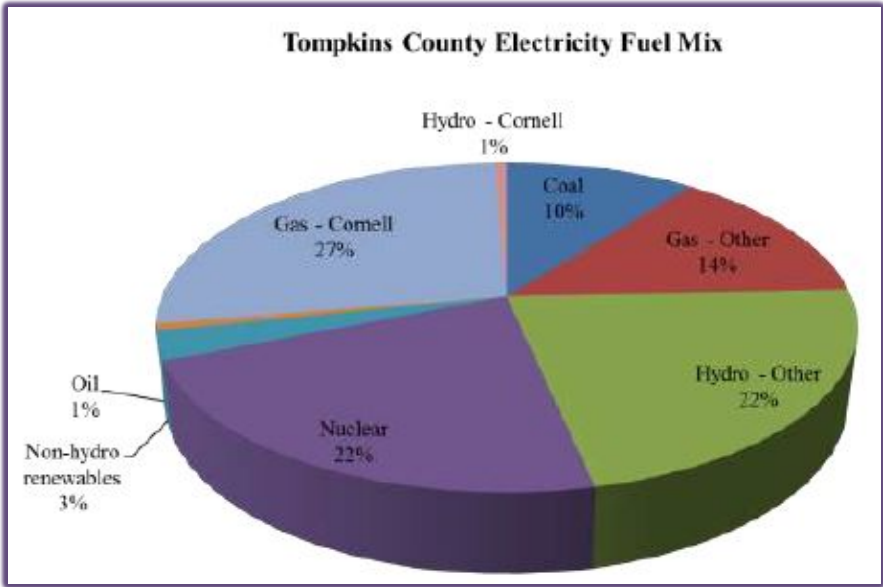
The chemical pollutants emitted by the TCAT buses are four-fold: Carbon Monoxide, Nitrous Oxides, Hydrocarbons, and Particulate Emissions.

- Two TCAT terrain scenarios result in approximately the following levels of noise pollution:
 - Flat terrain propulsion 80 – 85 decibels
 - Long steep uphill propulsion 95+ decibels ^Q
- For emphasis, especially in the elderly, 90 decibels is the threshold for hearing loss. ^R

According to the 2012 report (endnote B), Tompkins County electricity grid mix is shown at-right.

The 2016 report (endnote C) declares that by 2050, all nuclear power plants will be retired, 50% of the grid mix will then be methane, and the remaining 50% from “renewables” (ATTACHMENT 4).

Again, none of these reports mention ‘Conversion of the TCAT Bus Fleet to Electric Vehicle Mobility.’



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The Tompkins County Area Transport (TCAT) Bus Fleet – Background Brief – Con’t

Not seeking to single out any study paper/author in relation to ‘*Conversion of the TCAT Bus Fleet to Electric Vehicle Mobility.*’ Context #B above must be re-emphasized

- 2. The attitudes and lack of **long-term** foresight of local and state level New York officials, regarding energy plans, specifically as such relates to the incremental power demanded by **long-term** vision of electric mobility must be addressed/corrected.

Recent developments/announcements regarding electric mobility in New York State provide insight and confirmation regarding the lack of a ‘long-term vision of electric mobility.’ These announcements also provide a stark comparison to the global leader in EV mobility: China.

Announced by New York Governor Andrew Cuomo on July 9, 2018: ^S



Eleven? Also, it is no surprise that nowhere, in this otherwise laudable headline, do we find even a remote reference to ‘*Conversion of the TCAT Bus Fleet to Electric Vehicle Mobility.*’ As if purposely avoiding the ‘low hanging fruit,’ this article continues:

Alicia Barton, President and CEO, NYSERDA said, “With every new electric vehicle charging station installed, New Yorkers are finding it easier than ever to drive clean and drive electric. I congratulate Tompkins County for being a leader in making electric vehicles a cornerstone of their efforts to fight climate change and commend the County for joining Governor Cuomo’s nation-leading efforts to lower greenhouse gas emissions across New York.”

That is, this announcement insinuates that the primary culprit of “climate change” is not the state government or local municipalities, **which emit orders of magnitude more chemical and noise pollution;** but instead the culprit is the individual “New Yorker.”

There is nothing subtle about this deflection. Indeed, throughout nypa.gov websites (relating to EV mobility) we find the same “New Yorker” theme. But even if you disagree, the issue of avoiding the ‘low hanging fruit’ is indicative of a need to correct the issues of Context B.

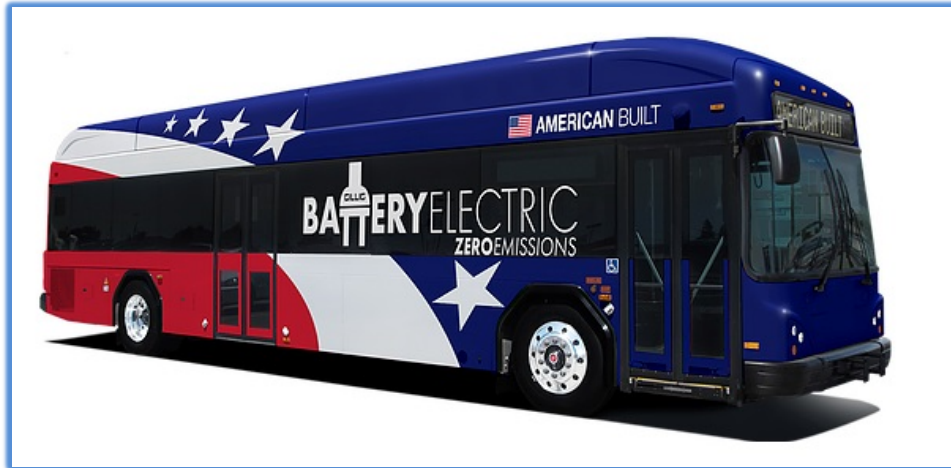
Memo: These eleven chargers are not capable of charging a TCAT EV bus with utility. Similar to the various reports although lauding Tompkins County, NYSERDA fails to accommodate ‘the low hanging fruit,’ *Conversion of the TCAT Bus Fleet to Electric Vehicle Mobility.*

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The Tompkins County Area Transport (TCAT) Bus Fleet – Background Brief – Conclusion

In a 2105 presentation it was estimated that the total energy expended in Tompkins County to produce its annual electricity demands was 2,659,769 million BTUs, or 780 gWh. ^T This equates to approximately 2 gWh per day. This is distributed to three primary users: Residential (38%), Commercial (44%) and Industrial (18%).

If all 54 TCAT buses were converted to the new 40 foot Gillig BEZE bus:



we assume that it too uses 500kW battery with a range of 255 miles. ^U The existing TCAT Gillig diesel buses average 40,000 miles per year, or 111 miles per service day. This allows one charge per day. Assuming a 100% charge, the incremental energy requirement for 54 BEZEs is 27 mWh, or less than 1% of the total daily electricity demand for Tompkins County.

Preamble to Proposal - Updating of the TCAT Mission/Vision Statement

The TCAT website lists the current Mission/Vision statement as follows:

Our Mission	Vision
To provide safe, high quality, reliable, efficient public transportation while being a responsive, responsible employer.	To become a model community transportation system committed to quality service, employee-management collaboration and innovation.

The updated statement needs to address the **Context Items A, B and C** (Page 4). Update should include a general commitment to protecting the environment and ecology of the Finger Lakes in a comprehensive manner. At the specific level, TCAT would therefore commit to elimination of chemical pollution and a drastic reduction of noise pollution endemic to its current fleet of diesel and diesel-hybrid buses. This Mission/Vision update will assist and accredit the TCAT execution of the Proposal vis-à-vis the key participants below.

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Preamble to Proposal - Participation and Assistance from the Stakeholders

With the updated Mission/Vision statement as a guide, both TCAT and those affected by its transport services (proximate residents that use or do not use these services) must openly solicit the focused participation in the *'Conversion of the TCAT Bus Fleet to Electric Vehicle Mobility.'* Those participants include at-least the following groups/individuals:

- ◆ Governor Andrew Cuomo and the New York State (Albany, New York), including the ongoing good works of NYSERDA
- ◆ Tompkins County Administrator Jason Molino
- ◆ Mayor Svante L. Myrick, City of Ithaca, New York
- ◆ Cornell University President Martha Pollack, including the Atkinson Center for a Sustainable Future, et al.
- ◆ Ithaca College President Shirley M. Collado
- ◆ The New York State Department of Transportation, including the State Operating Assistance (STOA) Fund Management
- ◆ Mr. Carl A. Taylor, President and Chief Executive Officer of the New York State Electric and Gas Company (NYSEG)

Preamble to Proposal - The Lack of a Bus EV Charging Infrastructure

Regarding NYSEG, the NYSERDA announcements lauding the Tompkins County to electric mobility efforts, nevertheless refer to such as being a merely "pilot" (Page 9 of 15 above).

As mentioned, this pilot status does not address the higher charge demands anticipated for a TCAT bus fleet conversion to full EV. Therefore focus must be placed on the specific technical needs of the larger batteries, transport bus duty cycles, and the routine charging logistics.

Examples of the charging infrastructure types (generically) include:

- Workplace charging (Destination)
- Street charging (Destination)
- In-Motion charging

The last, also called eHighways, is least feasible for the Finger Lakes topography. But work must begin on a regional up-fitting to a modern grid; a grid that is stable and Smart, allowing for V2X. Modern infrastructures elsewhere have demonstrated both Smart and fast charging.

Conversion of the TCAT Bus Fleet to Electric Vehicle Mobility An Exercise in True Sustainability and True Environmental Protection

Proposal

The stakeholders, and any others that are relevant, in the context of public service, should embark on a 'crash program' to implement the conversion of the TCAT bus transportation fleet in to full electric vehicles:

- Financing options should not be limited to outright purchase of the fleet; there are numerous commercial assistance programs already in-play, and these are specifically focused on municipal bus fleet conversion to EV. The relationship between China's BYD Bus Manufacturing and America's Generate Capital is one example. *

It is recommended that the stakeholders recognize the enormous long-term benefits of the TCAT conversion to EV in the context as '**low hanging fruit,**' and therefore the first step toward other transport system conversions, such as large trucks.

It recommended that no further consideration or funding be expended to the plug-in hybrid electric bus version (PHEV).

It is recommended that the stakeholders renew their knowledge of the current state of nuclear power as, not only a viable alternative to existing energy generation methods endemic to Tompkins County and the Finger Lakes, but one that is far superior in all relevant measures:

- This is especially requested/true with respect to the SMR as discussed in Attachment 7.

The elimination of the chemical and noise pollution from the TCAT diesel and diesel/hybrid fleet, by conversion to full EV, must not threaten the local beauty and appeal of the Finger Lakes region:

- The 'Three-Fold Summary of Context' discussed on Page 4 above, which forms the 'Basis of Proposal' should be prioritized.

It recommended that all endnotes and attachments be reviewed, as such will add depth to this proposal.

* [BYD and Generate Capital Take the 'Messiness' Out of Deploying Electric Buses](#)

[BYD Introduces New \\$200 Million Electric Bus Leasing Program In Partnership With Generate Capital](#)

Conversion of the TCAT Bus Fleet to Electric Vehicle Mobility An Exercise in True Sustainability and True Environmental Protection

ENDNOTES

^A Officially the Finger Lakes number 12, east to west: Cazenovia, Otisco, Skaneateles, Owasco, Cayuga, Seneca, Keuka, Canandaigua, Honeoye, Canadice, Hemlock and Conesus.

^B [Energy Supply and Demand - Tompkins County, New York](#)

^C [Tompkins County Energy, March 2016](#)

^D Although far beyond the scope/purpose of this instant essay, the term “fossil fuels” is at-best a misnomer; there is no such thing, The fact that those alleging competence/integrity continue to promote that misnomer is possibly deliberative is disturbing, see <https://www.youtube.com/watch?v=lynQAoWcd3o>

^E One categorical advantage, that is repeatedly emphasized by this author, is the many **safety** advantages of EV mobility; not the least of which involves the drastic reduction in severe-injury or death caused by hydrocarbon fires. Directly relevant and on-point to the instant subject, avoidance of human catastrophe surrounding the TCAT bus fire incident of March 23, 2018 was the result of [a deeply competent TCAT Bus Operator, Antoinette Briggs](#):



<http://cornellsun.com/2018/03/23/tcat-bus-catches-fire-on-state-highway-no-injuries-reported/>

The author has already written several letters regarding this implicit safety advantage of EV mobility, in the context of his safety expertise/experience. One such letter of over three years ago was directed at the efforts of Apple, Inc. to enter the EV manufacturing sector. [The 2015 letter to Apple Chairman Tim Cook here.](#)

Further discussion by author of fire-related safety can be sampled here:

<https://www.youtube.com/watch?v=9bbfPpIWYqI>

https://www.youtube.com/watch?v=TH_0izSyPk0

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- F <http://www.avta.com/index.aspx?page=482>
- G <https://www.youtube.com/watch?v=sLo3Pn4KC3w>
- H <https://news.schiphol.com/biggest-electric-bus-fleet-in-europe-at-and-around-schiphol/>
<https://www.youtube.com/watch?v=0hQP5Wjcgto>
- I <https://www.youtube.com/watch?v=cmXsxl-KbAc>
- J <https://dictionary.cambridge.org/us/dictionary/english/low-hanging-fruit>
- K [China's Shenzhen city electrifies all 16,359 of its public buses](#)
- L [EyeShenzhen article of December 28, 2017](#)
- M ['Clean Coal' Technologies, Carbon Capture & Sequestration](#)
- N <http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx>
- O http://pvsheridan.com/SAE-Xingyi_Xu_ShanghaiDajunTechnologies.pdf
- P <https://www.tcatbus.com/about/>
- Q Typical date here: <http://www.trolleycoalition.org/noise.html>
- R The author's expertise in the areas of diesel engine chemical and noise pollution results in-part from years of professional experience, see: [Critics Rave About Cummins Powered Dodge Ram Pick-ups.](#)
- S <https://www.nyserda.ny.gov/About/Newsroom/2018-Announcements/2018-07-09-Tompkins-County-EV-Charging-Stations>
- T [Tompkins County Energy Roadmap Fall 2015.](#) The text discussion above is based in Slide 13 from 2008 date, which has probably changed/increased in the last ten years.
- U [From the 2014 TCAT Annual report, the latest that is available.](#)

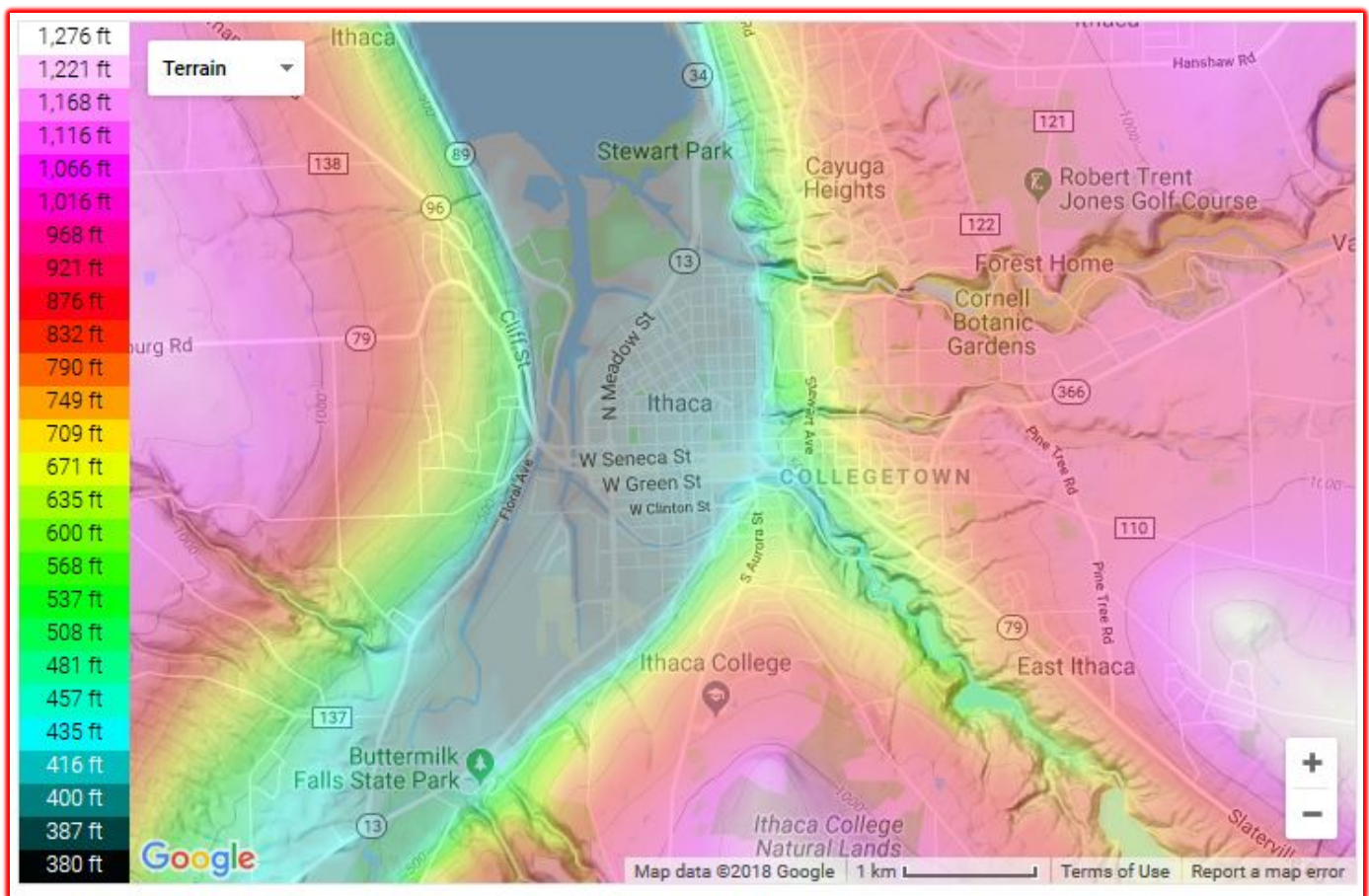
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Geographic Review

The beauty of the Finger Lakes Region is world-renown. The landscapes are as rugged as they are appealing. As the song of my alma mater, [Cornell University](#), declares:

“High above Cayuga’s waters . . .”

As an example, travel from the basin of Lake Cayuga to the Cornell or Ithaca College campuses requires long uphill drives, **with a change in elevation of up to 1000 feet:**



This terrain is routinely traversed by the Tompkins County Area Transportation (TCAT) system of buses. **TCAT diesel and diesel-hybrid buses** negotiate Ithaca and Tompkins County New York throughout the year, serving residents and university students with award-winning reliability (See Attachment 1 demographic review).

The steep uphill, passenger-loaded bus routes produce chemical pollution, **and the strain on the TCAT diesel powertrains are notoriously noisy.** These issues detract from the beauty and serenity of Ithaca, New York.



Conversion of the TCAT Bus Fleet to Electric Mobility An Exercise in True Sustainability and True Environmental Protection

One of the most beautiful regions of New York is called the Finger Lakes. Now officially comprised of 12 lakes in-total, the largest most populated county is Tompkins County, which has its spiritual, cultural and commercial center in the city of Ithaca, New York

Ithaca is home to two major academic institutions, making the population especially sensitive to the human condition, and how preservation of the environment is central to their well-being. That preservation however is intimately tied to ensuring that so-called solutions to environmental issues do not impinge in any way on the famous beauty of the Finger Lakes region.

There are two major academic institutions in Ithaca, Ithaca College, and my alma mater, Cornell University. Tompkins County houses Tompkins County Community College, and many technical and cultural learning centers; education is a major economic activity of the county. This academic focus contributes to a demographic that is much younger than the USA national median for cities/regions of similar population.

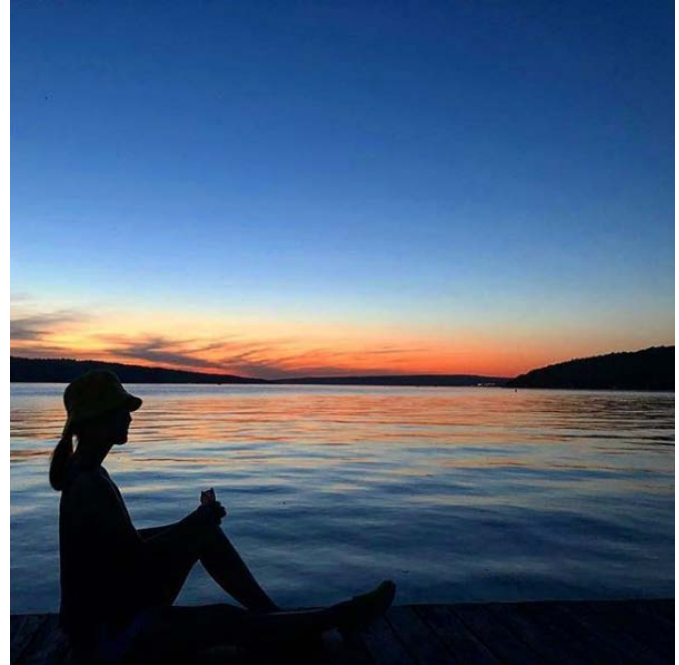
Relevant statisticsⁱ of the Tompkins County and Ithaca, New York:

	Ithaca New York	Tompkins County
Population	30,625	104,268
Median Age	21.8	30.3
Median Household Income	\$30,291	\$54,133
Median Property Value	\$219,100	\$182,600
Number of Employees	11,976	49,581
Poverty Rate	44.8%	20.1%
Households w/ One Vehicle	40%	28%
Households w/ Two Vehicles	31%	41%
Households w/ More than Two Vehicles	13%	24%
<u>Commuter Transport Modes:</u>		
Drove Alone	33.7%	63.2%
Car-Pooled	6.3%	8.6%
Commercial/Public Transport	12.6%	6.5%
Walked	37.8%	14.1%
Climate / Weather	Four Distinct Seasons	Four Distinct Seasons
Average Annual High Temperature	56.5° / 13.6°	~same
Average Annual Low Temperature	36.8° / 2.6°	~same
Average Annual Rainfall	37.3" / 95 cm	~same
Average Annual Snowfall	65" / 165 cm	~same
Sunny Days	154	~same
Precipitation Days	85	~same

ⁱ *Sources: [DATAUSA](#), [usclimatedata.com](#), [nerdwallet.com](#)

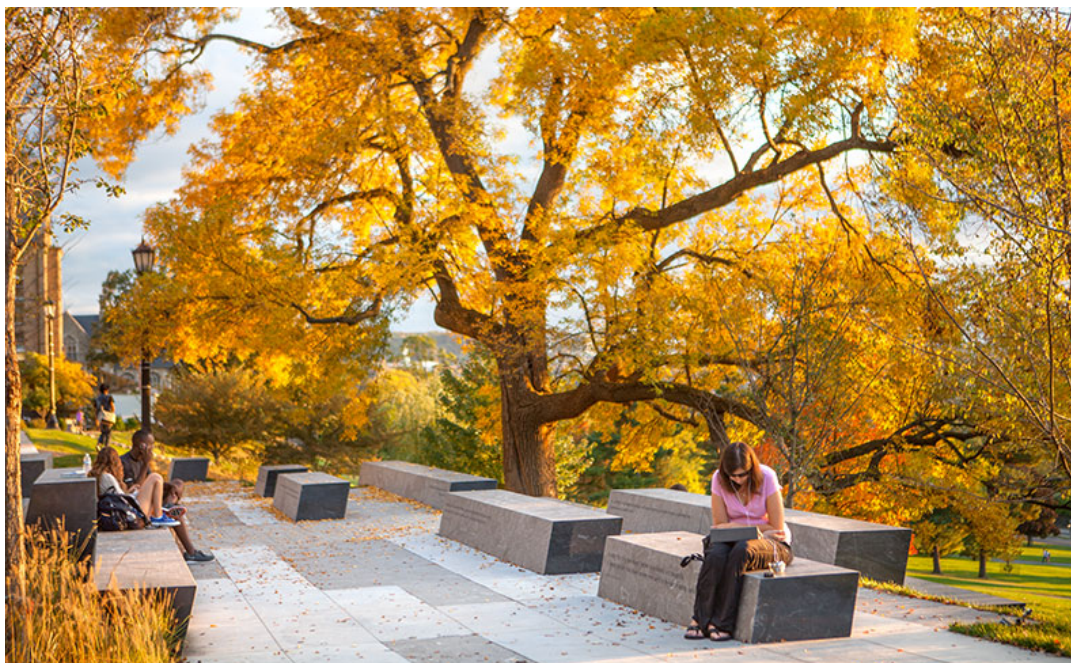
**Conversion of the TCAT Bus Fleet to Electric Mobility
An Exercise in True Sustainability and True Environmental Protection**

Space does not allow a complete photographic review, but the beauty of the Finger Lakes is a crucial part of the context of the discussion, and especially the Proposal discussed above:



<http://150.cornell.edu/glorioustoview/>

**Conversion of the TCAT Bus Fleet to Electric Mobility
An Exercise in True Sustainability and True Environmental Protection**



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Conversion of the TCAT Bus Fleet to Electric Mobility An Exercise in True Sustainability and True Environmental Protection

Brief Review/Critique of Renewables/Sustainability in Context of EV Mobility

An exemplar of the real-world performance of a nation that has zero nuclear power generation, and is converting its coal-fired power plants to renewable energy is Australia.

There are no plans to install modern nuclear power plants ala China. This is deeply ironic when one considers that Australia is the #1 miner/exporter of uranium, selling much of that resource to Asia and China.

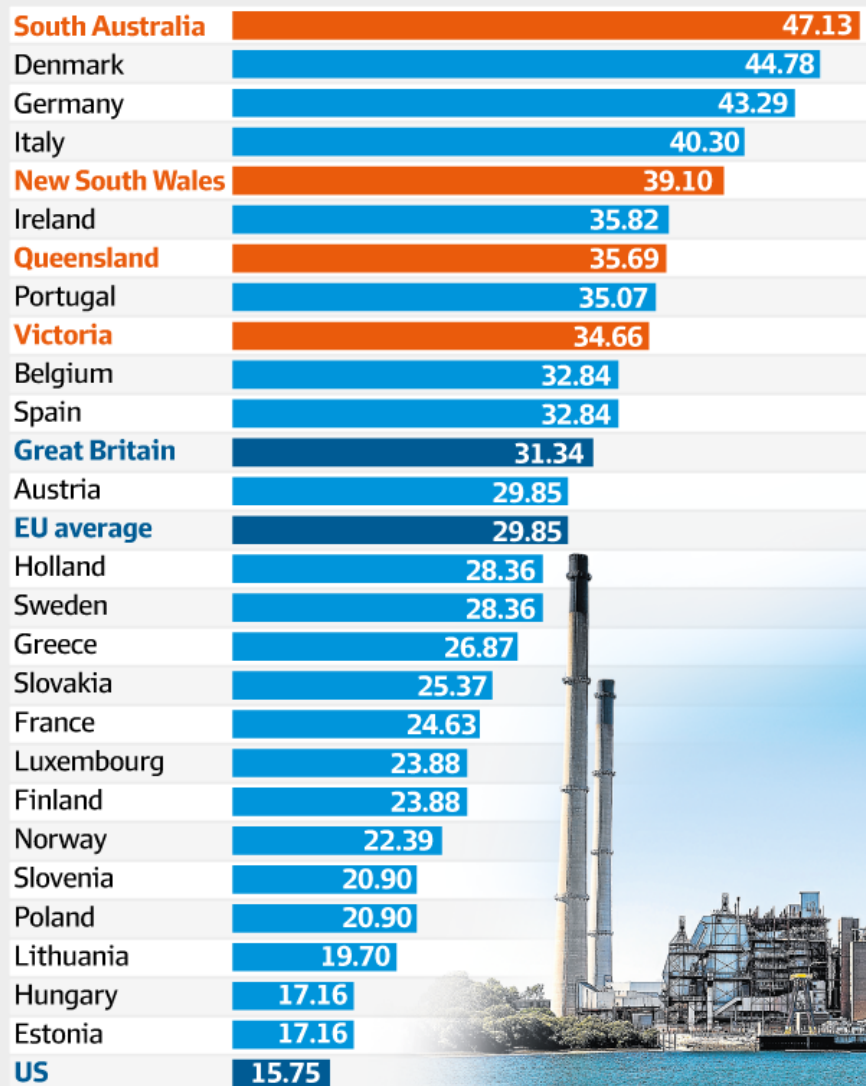
A more relevant irony, like China, Australia has historically relied most heavily on coal for electricity generation. Instead of a clean modern energy plan which includes nuclear, Australia is moving to solely to methane and so-called “renewables.” ^A

Recent data for the real-world effect this has had on its citizens at-right; They now pay more for their electricity than any other; over 3 times what the Americans pay.

Similar to the energy planners for Tompkins County New York, a vast majority of the renewables conversion in Australia involves the spattering of wind farms across the Australian landscape. ^B

**Memo: Such costly real-world results do not comport with plans to eliminate the chemical and noise pollution of ICE vehicles, especially the high-mileage bus fleets. ^C
These results also do not bode well for existing electricity rates in Ithaca, New York. ^D**

Retail electricity prices of NEM states, including taxes, compared to selected countries (¢ per kWh)



SOURCE: MARKINTELL, US ENERGY INFORMATION ADMINISTRATION

Although critique of the promoted opinions about “sustainability,” via wind farms and solar panels, goes far beyond the scope of this essay, **such is made more relevant by any plans which will stress the already outdated/inadequate electrical grids with the incremental demands borne by conversion of the transportation fleets to full electric.**

In that specific, but very important **long-term** context please see the following videos: ^E



<https://www.youtube.com/watch?v=tORmmTnr6A4&feature=youtu.be>



<https://www.youtube.com/watch?v=ZH4m-Cs-u3Y>



<https://www.youtube.com/watch?v=y-S0Pn3kOqo&feature=youtu.be>

<https://www.extremetech.com/extreme/188328-californias-new-solar-power-plant-is-actually-a-death-ray-thats-incinerating-birds-mid-flight>



If Solar Panels are so clean why do they produce so much toxic waste?

<https://www.forbes.com/sites/michaelshellenberger/2018/05/23/if-solar-panels-are-so-clean-why-do-they-produce-so-much-toxic-waste/#66c7816c121c>

<https://www.nationalreview.com/2017/06/solar-panel-waste-environmental-threat-clean-energy/>

Footnotes to ATTACHMENT 4

A <http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/australia.aspx>

B <http://www.cleanenergyregulator.gov.au/DocumentAssets/Pages/The-Renewable-Energy-Target-2016-Administrative-Report.aspx>

C <https://www.thegwpf.com/green-madness-australia-has-gone-from-cheapest-to-most-expensive-power/>

D <https://www.electricitylocal.com/states/new-york/ithaca/>

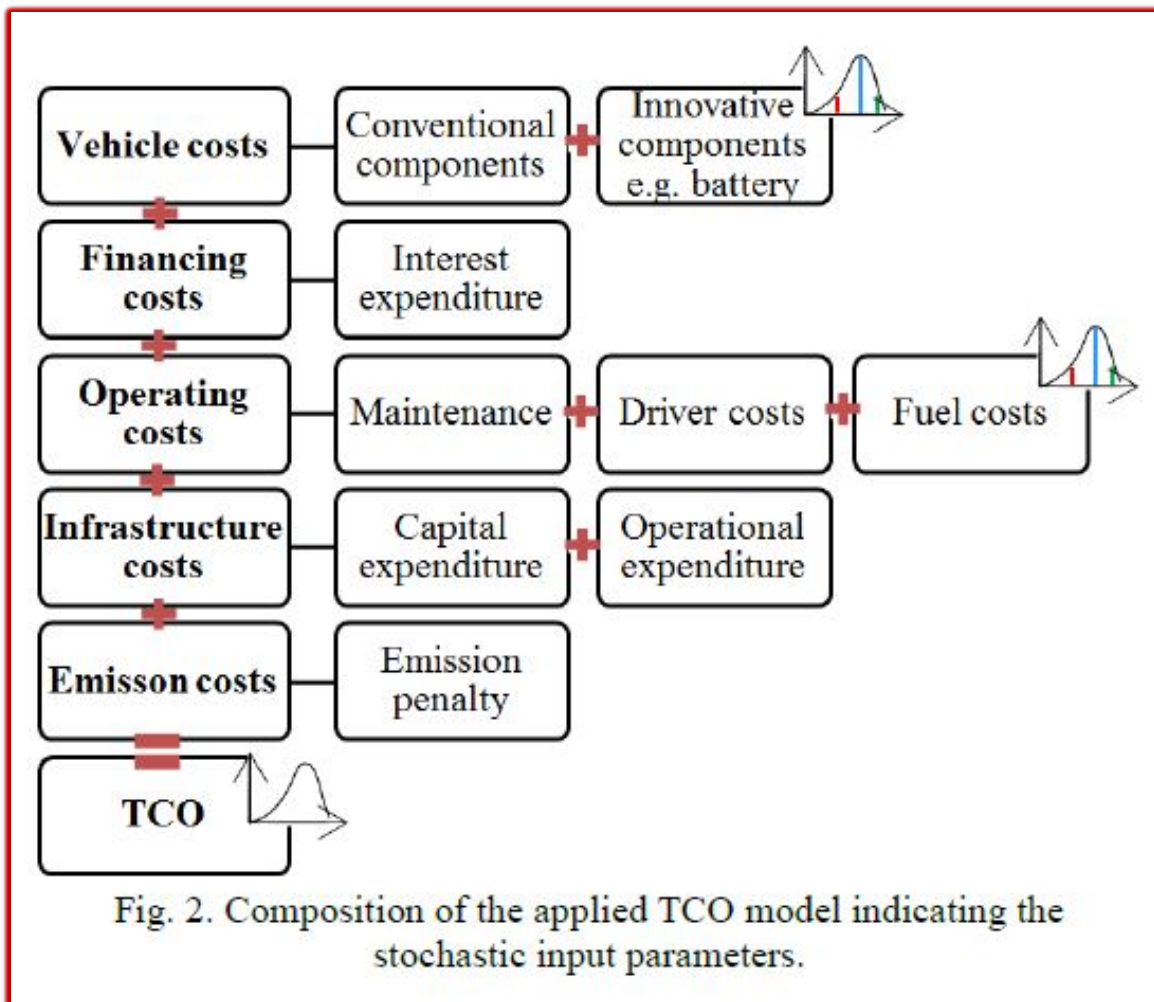
E To activate link or image, please hover over and click the Ctrl key, see hand, and then left click mouse.

**Conversion of the TCAT Bus Fleet to Electric Mobility
An Exercise in True Sustainability and True Environmental Protection**

Total Cost of Ownership (TCO) Benefit : BEB versus TCAT Diesel/Diesel-Hybrid

The TCO calculations/projections for the TCAT Battery-Electric-Bus (BEB) scenario is possible, complex, and requires the most up-to-date TCAT data (not publically published for 2017). TCO calculations for municipalities world-wide have already occurred and provide guidance; no need to re-invent-the-wheel. Between these TCOs and other benefits, it is clear that the municipal BEBs are already being justified and implemented.

A computer-based systems modeling approach to TCO is endorsed. The study by Goehlich and Kunith, ‘*Stochastic Total Cost of Ownership Forecasting for innovative Urban Transport Systems.*’ uses a BEB systems constituents and related algorithm structured as follows: ^A



Although the Bloomberg New Energy Finance (BNEF) study of 2018, Electric Buses in Cities includes municipality/fleet sizing sensitivity, it uses outdated BEB technology and charging infrastructure assumptions (available from City of Shenzhen scenario of a year earlier). ^B

This BNEF deficiency is pointed out, not as diatribe but to further alleviate the current misconceptions, especially by officials of municipalities, that large vehicle conversion to full electric is not viable; relating to long-haul trucks and transport buses.



For example, in his blog *‘Electric Trucks: Economically and Environmentally Desirable but Misunderstood,’* Auke Hoekstra, Senior Research Fellow at Eindhoven University of Technology, addresses this misconception concern:

“In this blog series we will calculate the cost per kilometer of a heavy-duty long-haul battery electric truck. The real thing! We add this option to the comprehensive report *‘The Future of Trucks’* that the International Energy Agency published this month. **This report strangely omits this option from its comparison**, even though we will see it is both the best way to combat global warming and to decrease costs.” (underline/bolding added) ^C

Mr. Hoekstra is correct in his concern that the IEA, as late as 2017, would omit large vehicle electrification; demonstrating the broad-based misconception on the part of officials.

He is NOT correct when ostensibly claiming that the ‘heavy-duty long-haul battery electric truck’ represents the low-hanging fruit. That BEBs are already being justified/implemented is proof that the BEB owns that distinction. The following headline furthers that opinion: ^D

A screenshot of a webpage from Electrek. The page has a teal header with the 'electrek' logo in white and blue. Below the logo are navigation links: 'Automakers', 'Alt. Transport', 'Autonomous Driving', and 'Energy', each with a dropdown arrow. A black bar below the navigation contains the date 'OCTOBER 23, 2017'. The main headline reads '12 major cities pledge to only buy all-electric buses starting in 2025'. At the bottom, it says 'Fred Lambert - Oct. 23rd 2017 12:59 pm ET' followed by a Twitter icon and the handle '@FredericLambert'.

electrek

Automakers ▾ Alt. Transport ▾ Autonomous Driving ▾ Energy ▾

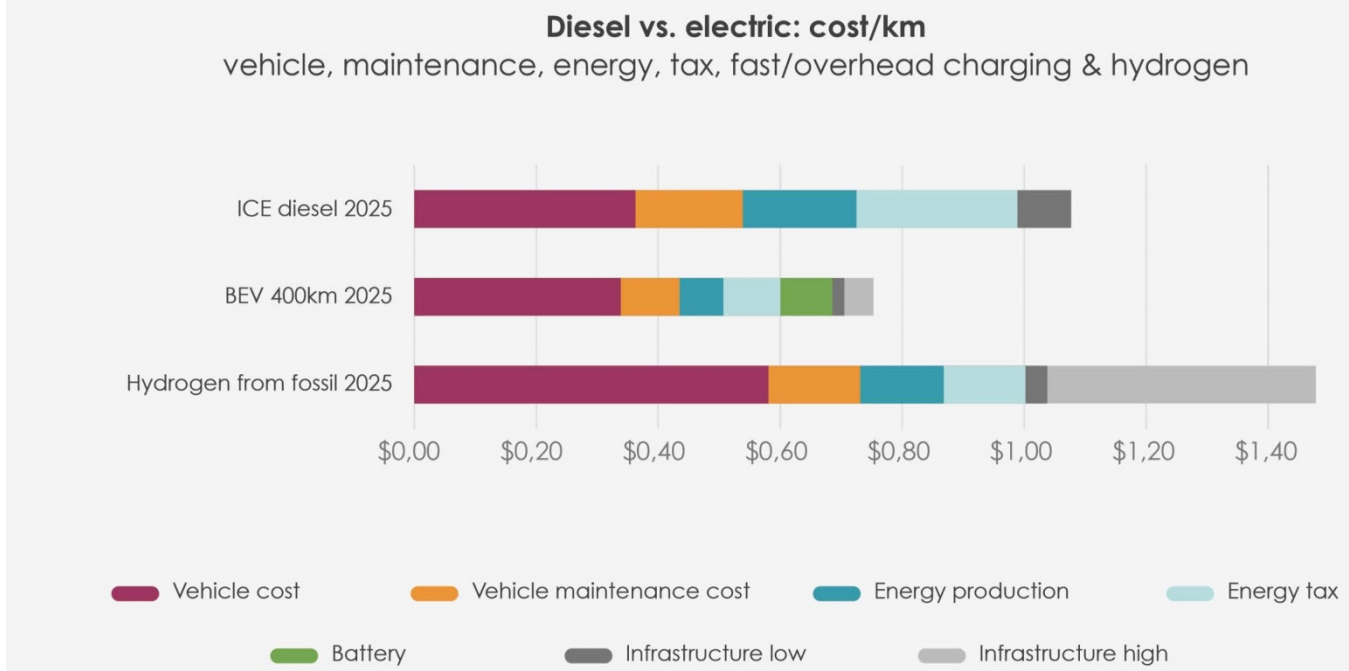
OCTOBER 23, 2017

12 major cities pledge to only buy all-electric buses starting in 2025

Fred Lambert - Oct. 23rd 2017 12:59 pm ET [@FredericLambert](#)

In his blog Mr. Hoekstra offers a glimpse of the many TCO benefits for large vehicle electrification with a graph focused on fuel costs: ^E

Full Electric Trucks: economics



Low-Hanging Fruit



When we include all constituents of the TCO (Emissions, Infrastructure, Operating, Financing and Vehicle), and project for future developments, the BEB is the clear winner of the 'low hanging fruit' contest. ^F

Endnotes to Attachment 5

- A [Stochastic Total Cost of Ownership Forecasting for innovative Urban Transport Systems](#)
- B [Bloomberg Electric Buses in Cities](#)
- C [The Future of Trucks - Implications for Energy and the Environment](#)
- D [12 Major Cities Pledge All-Electric](#)
- E [Electric Trucks: Economically and Environmentally Desirable but Misunderstood](#)
- F [Advanced Electric Bus Systems – TCO Studies and Modeling](#)

Conversion of the TCAT Bus Fleet to Electric Mobility
An Exercise in True Sustainability and True Environmental Protection

Do Wind Farms Fulfill ‘True Sustainability and True Environmental Protection’ ?

Perspective on an answer . . . In February 2018 the author attended the Society of Automotive Engineers (SAE) symposium in San Diego, California: ^{A B}



Among the many presentations was that of the California Energy Commission (CEC) entitled, *‘Plug-In Electric Vehicle Infrastructure for California : Deployment and Integration.’* At conclusion, during the Question & Answer portion, the author seated in the front row, asked:

“ It has just been announced that the last of California’s nuclear power plants, Diablo Canyon, will be shut down. That means that the only nuclear power available to California will be imported from sites such as Palo Verde. What is the CEC plan to replace that power given its concerns about the incremental power needed for electric mobility? ”

To an audience of 400+ attendees, the CEC had no specific answer, no general answer, no recommendation who to contact for an answer; he raised his voice and impolitely blurted:

“Well . . . I’m not the nuclear guy!” ^C

The SAE audience was stunned, and repulsed. Many conferred with the author during a break, asking the proverbial *“What the heck?!”* as an indication of their shock, and as consolation. ^D

The notion that **thee** heart-n-soul of the California energy officials would not be prepared to address a direct, relevant, on-point question, that was prompted by recent news local headlines that had global coverage, was not merely staggering for the learned audience, but as it turns out, **it was Prophetic !**

California power grid urges consumers to conserve energy in heat wave



Reuters • July 23, 2018



(Reuters) - California's power grid operator on Monday issued an alert to homes and businesses to conserve electricity on Tuesday and Wednesday when a heat



wave is expected to blanket the state.

Just to be clear, in case the likes of the CEC missed it, **it is not unusual for “heat waves” to hit southern regions of desert states in summer.** As sentient beings, living in the 21st century, in what is referred to as the “world’s last remaining superpower,” are we not supposed to be prepared for that obvious, ever-repeating scenario? ^{E F}

The comments from news readers world-wide poured in:

510 reactions 😊 4% 😬 81% 😡 15%

[Sign in to post a message.](#)

Top Reactions 👤 175 viewing

P Patrick 15 hours ago ⋮
What happened to these wind turbines and solar panels?
↩ Reply Replies (27) 👍 256 🗨 4

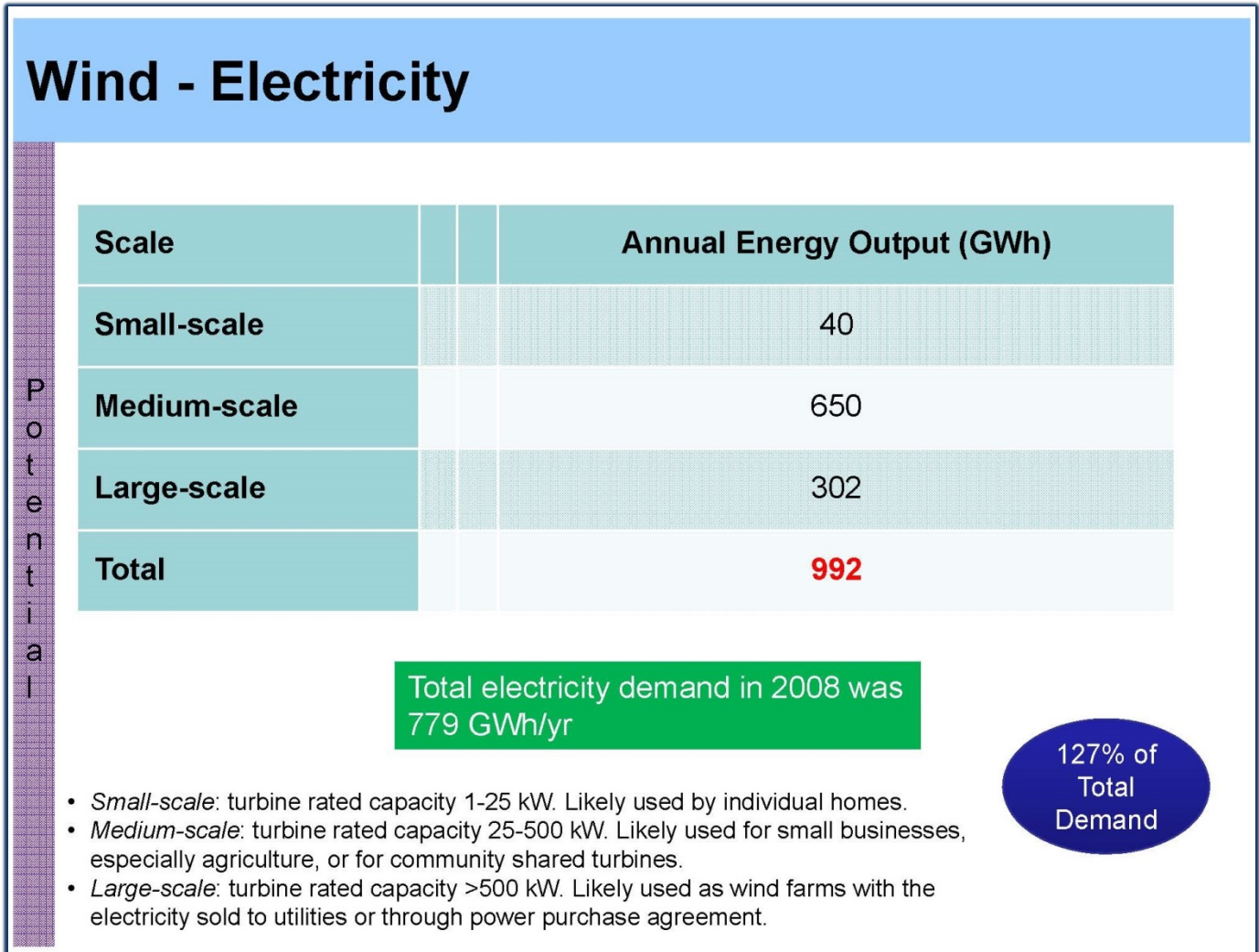
R Randall 15 hours ago ⋮
Now, about that renewable / green energy?
↩ Reply Replies (19) 👍 263 🗨 4

SA Sean Alexander 15 hours ago ⋮
So how's all that renewable energy working out?
↩ Reply Replies (7) 👍 196 🗨 1

[Show More](#)

Are the plans for “renewables” for the Finger Lakes any more robust than that of the CEC and California? Are the New York plans any more “sustainable” in the context of electric mobility?

In the 2015 study ‘*Tompkins County Energy Roadmap*’ we find various proposals for the future, none of which involve modern nuclear power. Slide 19 discusses the commitment of New York planners to the installation of wind farms throughout the beautiful Finger Lakes region:



To put Slide 19 in perspective for Tomkins County residents, calculations relating to the unstated consequences of the ‘Annual Energy Output (GWh)’ for each of the turbine scales; Small, Medium and Large. **So . . . How many turbines are hidden behind the output proposals?** We assume median outputs for each scale (see ranges in footnotes above):

Small-scale	=	15 kW	40 GWh	=	913 turbines
Medium-scale	=	250 kW	650 GWh	=	890 turbines
Large-scale	=	500 kW	302 GWh	=	<u>207 turbines</u>

Total turbines required **2010 turbines**

Similar to their counterparts at the CEC, it is unlikely that the full implications of the *'Tompkins County Energy Roadmap'* were spelled out for area resident, **in an open forum.** Typically these types of "sustainable" discussions are held behind-closed-doors, and only later are the specifics of the plans revealed to those most directly affected. This type of vested-interest-prioritized "planning" has no place in a modern society. ^G

Obviously the *'Tompkins County Energy Roadmap'* does not specify that all of the future Finger Lakes energy be comprised solely of wind turbines. The calculation in meant for perspective, relating to a theme of comprehensive protection of the area environment and ecology. But my calculations are generous to the point of being ludicrous. For example, I assumed twofold:

(1) That the **capacity rating** of each of the turbine was (2) produced during a full **eight** hours of **every** day. That, of course, is silly. ^{H I J}





A bald eagle is nesting upon a burned out, rusting eyesore in California. Luckily his fate did mirror those described in Attachment 4 above. ^K

It is estimated that the US taxpayer has subsidized the wind turbine industry with \$2.3 billion, with more already budgeted.

But let us answer the question posed by this attachment:

Do Wind Farms Fulfill *'True Sustainability and True Environmental Protection'* ?

No. Especially in the evolving context of electric mobility and the latter's requirement for reliable, non-intermittent, pollution free, and substantial incremental electrical energy.

ENDNOTES TO ATTACHMENT 6

A [Author attended the Society of Automotive Engineers \(SAE\) symposium in San Diego, California](#)

B <https://saeevents.org/>

C [SAE CEC February 2018](#)

D [California approves closure of last nuclear power plant](#)

Commenting on her actions leading to the closure of the last nuclear power plant in California, Commissioner Liane M. Randolph (pictured) stated: **“It moves California away from the era of nuclear power and toward the era of zero-carbon renewable energy.”**



E [California power grid urges consumers to conserve energy in heat wave](#)

F [California energy review](#)

G [Tompkins County Energy Roadmap – Fall 2015](#)

H 365 days * 24 hours = 8960 hours per year / 3 = 2920 hours, or 8 hours per day. Silly, especially for the Finger Lakes region. Whenever I fly from Michigan to Ithaca, New York, I peer out of the Delta airliner window to observe the usual . . . beginning in western New York state are hundreds of already installed wind turbines . . . just sitting there, doing absolutely nothing . . . except plighting the landscape.

I [Critics and Supporters Agree – Giant Wind Turbines Are Ugly!](#)

J [Shocking Before-And-After Photos: How Wind Parks Are Devastating Idyllic German Countryside!](#)

K [Retiring Worn-out Wind Turbines Could Cost Billions that Nobody Has](#)

Conversion of the TCAT Bus Fleet to Electric Mobility
An Exercise in True Sustainability and True Environmental Protection

**The Incremental Energy Demanded by the Electric Mobility Paradigm –
The Need to Protect the Grid Base Load from the Intermittency of “Renewables”**



If you listen to the pundits and vested interests of so-called “renewables” long enough they will convince you that no progress has been made in the area of nuclear power plant engineering, and that the status and format of nuclear power technology remains at the level of the 1958 Ford Edsel.



That same year, 1958, the world’s first nuclear powered vessel, the USS Nautilus submarine (SSN-571), broke through the ice cap of the exact geographic North Pole under the top secret exercise, Operation Sunshine. Prior, on January 17, 1955, its Commanding Officer Eugene Wilkinson cast off and signaled the historic message, **“Underway On Nuclear Power!”** In a few short years the SSN-571 shattered all submerged speed and distance records. From 1954 until its decommissioning in 1989, **the Nautilus steamed for over 500,000 miles without incident.**

The world no longer makes Ford Edsels. Likewise, the world no longer designs nuclear power plants such as Chernobyl, or Three Mile Island, or Fukushima. But you would never know that judging from the words and deeds of Western politicians and the vested interests connected to “renewable energy.”

The world also no longer makes the USS Nautilus, despite its original marvel of engineering, with its unblemished operational record. The world has moved on to Generation III nuclear power plants such as the Westinghouse AP-1000, and the VVER-1200. ^A

But the move to the modern nuclear power is not happening in the United States. In fact, under the influence of pundits and vested interests, **the average age of US nuclear power plants has shot up to more than 30 years:**

“Almost all the US nuclear generating capacity comes from reactors built between 1967 and 1990. Until 2013 there had been no new construction starts since 1977.”^B

With a construction start in 1973, the most recent US power plant to come online was Watts-2:

“During the 20 years that Watts Bar 2 fizzled, China has built 7 new nuclear power plants.”

In China, that average age of their nuclear plants is less than 10. And to be clear, the seven that China built are not 1958 Ford Edsels . . . neither are the upcoming builds.

Not a Peep from “The Swamp”

It is ironic that President Donald Trump has been chastising the nation of China regarding its alleged thief of intellectual property . . . but not a peep about China’s aggressive move into building the Westinghouse AP-1000 . . . the most modern of Generation III designs . . . **a stunning example of American “intellectual property.”**

WORLD NUCLEAR
ASSOCIATION

Embarking upon Generation III plants

In September 2004, the State Council approved plans for two units at Sanmen, followed by six units at Yangjiang (two to start with), these to be 1000 or 1500 MWe reactors pioneering Generation III nuclear technology from overseas. The Sanmen (in Zhejiang province) and Yangjiang (in Guangdong province) reactors were subject to an open bidding process for third-generation designs, with contracts to be awarded in mid-2006 – in the event, mid-2007 – putting them clearly into the 11th Five Year Plan.

Construction in Sanmen, China of the American-designed Westinghouse AP-1000:^C



As the Saying Goes, “Timing is everything” - The Convergence

China is serious about eliminating coal; they are committed to electric mobility. Their nuclear power focus to accomplish both is the large scale; plants that produce in the gigawatt range: ^D

Units	Province	Net capacity (each)	Type	Operator	Grid connection	Commercial operation
Daya Bay 1&2	Guangdong	944 MWe	French M310	CGN		
Qinshan Phase I	Zhejiang	298 MWe	CNP-300	CNNC	Dec 1991	April 1994
Qinshan Phase II, 1&2	Zhejiang	610 MWe	CNP-600	CNNC	Feb 2002, Mar 2004	April 2002, May 2004
Qinshan Phase II, 3&4	Zhejiang	619, 610 MWe	CNP-600	CNNC	Aug 2010, Nov 2011	Oct 2010, Dec 2011
Qinshan Phase III, 1&2	Zhejiang	677 MWe	Candu 6 PHWR	CNNC	Nov 2002, June 2003	Dec 2002, July 2003
Fangjiashan 1&2	Zhejiang	1012 MWe	CPR-1000 (M310+)	CNNC	Nov 2014, Jan 2015	Dec 2014, Feb 2015
Ling Ao Phase I, 1&2	Guangdong	950 MWe	French M310	CGN	Feb 2002, Sept 2002	May 2002, Jan 2003
Ling Dong/Ling Ao Phase II, 1&2	Guangdong	1007 MWe	CPR-1000 (M310)	CGN	July 2010, May 2011	Sept 2010, Aug 2011
Tianwan 1&2	Jiangsu	990 MWe	VVER-1000/V-428	CNNC	May 2006, May 2007	May 2007, Aug 2007
Tianwan 3	Jiangsu	1060 MWe	VVER-1000/V-428	CNNC	Dec 2017	Feb 2018
Ningde 1&2	Fujian	1018 MWe	CPR-1000	CGN & Datang	Dec 2012, Jan 2014	April 2013, May 2014
Ningde 3&4	Fujian	1018 MWe	CPR-1000	CGN & Datang	Mar 2015, Mar 2016	June 2015, July 2016
Hongyanhe 1&2	Liaoning	1061 MWe	CPR-1000	CGN & SPI	Feb 2013, Nov 2013	June 2013, May 2014
Hongyanhe 3&4	Liaoning	1061 MWe	CPR-1000	CGN & SPI	Mar 2015, April 2016	Aug 2015, Sept 2016
Yangjiang 1&2	Guangdong	1000 MWe	CPR-1000	CGN	Dec 2013, Mar 2015	March 2014, June 2015
Yangjiang 3&4	Guangdong	1000 MWe	CPR-1000+	CGN	Oct 2015, Jan 2017	Jan 2016, Mar 2017
Yangjiang 5	Guangdong	1000 MWe	ACPR1000	CGN	May 2018	July 2018
Fuqing 1&2	Fujian	1020 MWe	CPR-1000 (M310+)	CNNC & Huadian	Aug 2014, Aug 2015	Nov 2014, Oct 2015
Fuqing 3&4	Fujian	1000 MWe	CPR-1000 (M310+)	CNNC & Huadian	Sept 2016, July 2017	Oct 2016, Sept 2017
Fangchenggang 1&2	Guanxi	1000 MWe	CPR-1000	CGN	Oct 2015, July 2016	Jan 2016, Oct 2016
Changjiang 1&2	Hainan	601 MWe	CNP-600	CNNC & Huaneng	Nov 2015, June 2016	Dec 2015, Aug 2016
Taishan 1	Guangdong	1660 MWe	EPR	CGN	June 2018	
Sanmen 1	Zhejiang	1157 MWe	AP1000	CNNC	June 2018	
Total: 41		38,419 MWe				

As the Saying Goes, “Timing is everything” - The Convergence – Conclusion

The convergence of the latest, modern nuclear power based electricity production concepts (and the resulting plant designs) and that of the electric vehicle paradigm has greatly favored China; they are poised at the right ‘time & place’ in history.

The Small Modular Reactor (SMR) – The Right Time & Place in American Energy History

But regarding that convergence, there is a nuclear power technology that greatly favors the USA. It is safe . . . it is scalable, it is American . . . it is as reliable as it is powerful . . . it is affordable . . . **and it will protect the Finger Lakes environment and ecology in a comprehensive manner** (versus the blight of so-called “renewables”) . . . the Small Modular Reactor (SMR).

Because of the powerful grip upon the American economy and psyche, by everyone from Big Oil to the vested interests of “renewable energy,” it is doubtful that the average American citizen is knowledgeable about SMRs . . . that is about to change.

A proverbial game-changer for the SMR occurred this past April 2018 . . .

The headlines read:

NuScale Power’s Small Modular Nuclear Reactor Becomes First Ever to Complete Nuclear Regulatory Commission’s **Phase 1 Review.** ^E



In related announcements, the Assistant Secretary for the US Department of Energy (DOE), Office of Nuclear Energy, qualified further this news: ^F

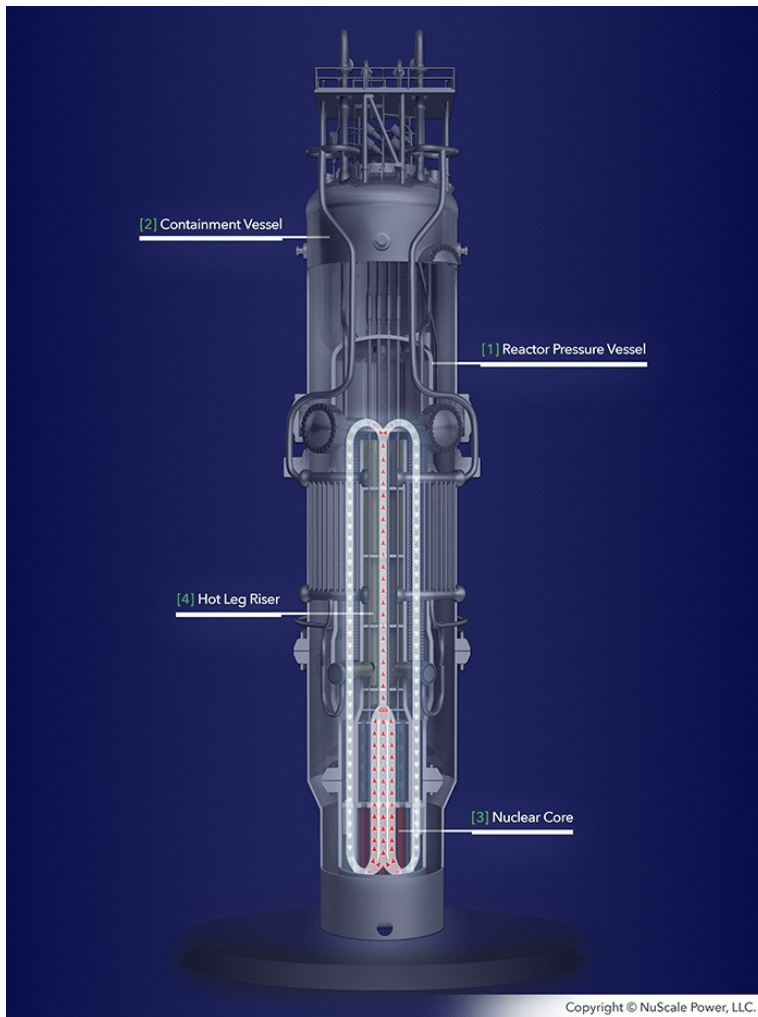
"As opposed to an \$8 billion unit for a gigawatt or larger before financing, you’re looking at a unit that may cost \$1 billion to \$1.5 billion put that base plant in, with \$350 million to \$450 million per unit to add to it, allowing a utility to take bites at a time. That could break down significant barriers to nuclear generation at smaller utilities, and in countries with limited finances or smaller grids that do not need large-scale reactors. I think the implication is potentially dramatically opening up a market, a market that would never have materialized with large reactors. As valuable as large reactors still are, we simply have utilities that don't have the financial wherewithal and also are very excited about the design attributes."

Small Modular Reactor (SMR) – The Right Time & Place in American Energy History – Con't

These statements are especially fortuitous for the title of this instant essay:

“Conversion of the TCAT Bus Fleet to Electric Mobility –
An Exercise in True Sustainability and True Environmental Protection.”

The fact that the SMRs “could break down significant barriers to nuclear generation at smaller utilities” points to an option that Tompkins County and New York have not considered in their prior energy plans for the Finger Lakes region. It is time to do so.



The NuScale SMR is very feasible for the Finger Lakes.

Its footprint would be orders of magnitude smaller than the proposed solar panels parks and wind turbine farms.

A single integrated unit is called the NuScale Power Module (NPM).

The base NuScale SMR is rated at 50 mW, and recent technology improvements have raised that rating to 60 mW. But it is also scalable, so the total power capacity can be raised to the 300 mW range or higher.

The ‘Phase 1 Review’ includes specifically acknowledges the compact NPM design, which allows factory assembly, and later, shipment to the site for deployment.

Referencing Page 3 of Attachment 6 above, the annual electrical energy requirements for Tompkins County are about 780 gWh.

Memo: This requirement is *prior to* the electric mobility paradigm, and its implicit increment energy requirements.

Conclusion: A single location dual NPM NuScale SMR, or two distinct SMRs, are all that would be needed to power all of Tompkins County, including the future conversion of the TCAT bus fleet to full electric. Assuming continuous year-long operation, the two NPMs would generate 525 mWh each, a total of just over 1 tWh. (The author prefers that three NPMs be considered.)

Total electricity demand in 2008 was
779 GWh/yr

Small Modular Reactor (SMR) – Right Time & Place in American Energy History – Conclusion

For a detailed review of the year-ago status of the US nuclear power industry, including discussion of the NuScale SMR, I recommend the PBS Nova program, The Nuclear Option: ^G



In this Nova program you will also be introduced to the Bill Gates nuclear power research company called TerraPower. ^H

ENDNOTES TO ATTACHMENT 7

-
- A [Nuclear Power in Russia](#)
 - B [Nuclear Power in the USA](#)
 - C [Westinghouse AP1000 nuclear power plant](#)
 - D [Nuclear Power in China](#)
 - E [NuScale's SMR Becomes First Ever to Complete NRC Phase 1 Review.](#)
[NuScale Power Design Certification Project](#)
 - F [SMRs a 'game-changer' for US nuke industry, DOE tells Congress](#)
 - G [PBS Nova program, The Nuclear Option](#)
 - H [TerraPower website](#)

**Conversion of the TCAT Bus Fleet to Electric Vehicle Mobility
An Exercise in True Sustainability and True Environmental Protection**


End of Document

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The Safety and Efficiency of the Transportation Fleet

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First and Foremost Safety is a
Management Issue

DDM CONSULTING
The Safety and Efficiency of the Transportation Fleet