Hi Ginger-

Here’s a document on alternative power for rail. It’s already four years old, though, and things are changing fast.

Bruce
State-of-the-Art in Light Rail Alternative Power Supplies

Prepared for:
APTA / TRB 2015 Light Rail Conference

Authors:
John Swanson and John Smatlak
Interfleet Technology Inc.
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BACKGROUND
Since the beginning of electrified rail transit in the 1880s, the conventional overhead contact system (OCS) has been the preferred power distribution method for light rail/streetcar/tramway systems (referred to collectively in this paper as “light rail”) throughout the world. Although there have been a number of other approaches tried, all were ultimately found wanting. More recently however, several modern versions of alternative power supply options have entered the marketplace, including onboard energy storage and ground level power supply, allowing operation of vehicles without an OCS (“off-wire”) over part or all of the alignment.

The application of alternative power supplies is a complex subject that is best approached from a systems viewpoint, rather than just the vehicle or the electrification system. In the end, the goal is to provide reliable, continuous traction power to the rail vehicle and there are number of ways this may be done. Followers of this subject will have seen many papers over the years that have identified, described and evaluated many of these methods.

PURPOSE
The purpose of the paper is to examine progress during the last decade in the rapidly changing development of alternative power supply for light rail and to identify major technological advances and trends likely to impact the industry in the coming decade.

METHODS
The authors have conducted an ongoing literature survey, and utilized personal experience, onsite visits and collaborative information exchange with suppliers and users of the technology to develop this paper.

RESULTS
Ten years ago (2005), there were no light rail systems in commercial service using onboard energy storage for off-wire operation, and only one system using ground level power supply (Bordeaux). By the end of 2015 there are expected to be eight cities with ground level power supply systems in commercial service, and nine systems using onboard energy storage for off-wire operation (growing to 13 by the end of 2016). There are also several more systems of both types under construction. Development of battery, supercapacitor, flywheel and hybrid onboard energy storage systems also continues, as does onboard power generation using hydrogen fuel cells.

CONCLUSIONS
1. Alternative power supply methods for light rail are entering a new phase of development. Compared to ten years ago, there are now a significantly larger number of ‘early adopter’ systems either in commercial service or under construction. While that number is still small compared to the over 400 light rail systems worldwide, interest is strong and the experience gained in operating these systems is expected to facilitate additional improvements and can provide specific information on operating costs, including the life span of energy storage devices, and thus life cycle costs. This will hopefully provide decision makers with additional points to consider and some initial hard data that they currently do not have access to.

2. Proprietary technology issues remain a major factor

3. Application of the technology remains very project specific and may require vehicle performance tradeoffs. Design requires careful analysis of alignment and duty cycle, including local climate factors. There is also a need for more sophisticated tools to properly analyze the various system characteristics and consider a variety of scenarios in order to arrive at a reliable, cost effective off-wire system design

4. Onboard energy storage has multiple uses; it is also used for energy savings by increased recuperation of regenerative braking.
Since the beginning of electrified rail transit in the 1880s, the conventional overhead contact system (OCS) has been the preferred power distribution method for light rail/streetcar/tramway systems (referred to collectively in this paper as “light rail”) throughout the world. Although there have been a number of other approaches tried, all were ultimately found wanting. More recently however, several modern versions of alternative power supply options have entered the marketplace, including onboard energy storage and ground level power supply, allowing operation of vehicles without an OCS (“off-wire”) over part or all of the alignment.

The application of alternative power supplies is a complex subject that is best approached from a systems viewpoint, rather than just the vehicle or the electrification system. In the end, the goal is to provide reliable, continuous traction power to the rail vehicle and there are number of ways this may be done. Followers of this subject will have seen many papers over the years that have identified, described and evaluated many of these methods.

For those who are new to the subject, there are three basic means, as well as emerging hybridized combinations (indicative of how rapidly the technology is evolving):

1. Ground level power supply (GLPS) – power continuously supplied to the vehicle at ground level via direct contact with a conductor or inductively
2. Onboard energy storage system (OESS) – power stored on the vehicle, using flywheels, batteries, supercapacitors or a combination thereof, recharged periodically via regenerative braking and contact with a power conductor
3. Onboard power generation system (OPGS) – power continuously generated on the vehicle as required via hydrogen fuel cells, microturbines or diesel engines

The advantages of these alternative power supply methods center around providing improved aesthetics and the reduction of conflicts with other users of the street space including utilities, bridges, traffic signals and other overhead structures, as well as special events (such as parades), etc.

In the case of OESS, the related infrastructure is also simplified, in some cases reducing short term (capital) and long term (maintenance) infrastructure costs.

The disadvantages include increasing the complexity of the vehicle (OESS) or the wayside infrastructure (GLPS) that may lead to increased capital and/or vehicle life cycle costs. With OESS there are also weight, space and performance tradeoffs, as well as the unknown life expectancy of OESS elements.
Only ten years ago (2005), there were no light rail systems in commercial service using OESS for off-wire operation, and only one system using a GLPS (Bordeaux). After a relatively slow start, by the end of 2015 there are expected to be in commercial service:

1. 8 systems using GLPS, with at least 5 more under construction (Table 1)
2. 9 systems using OESS for off-wire operation, with at least 8 more under construction (Table 2)
3. 4 systems using OPGS (diesel hybrid light rail vehicles) for off-wire operation (Table 3)

Significantly, the lengths of the off-wire segments, whether powered by GLPS or OESS, have been slowly increasing, and in a few cases the entire length of a line uses alternative power supply.

Meanwhile, the supporting development of battery, supercapacitor, flywheel and diesel hybrid alternative power systems, as well as onboard power generation using hydrogen fuel cells, has continued on at least 27 prototype / development vehicles (Table 4), with more to come. There are also a number of systems using on-board energy storage primarily for energy saving purposes (Table 5), which as a side benefit, are also in many cases capable of moving a vehicle very short distances off-wire (e.g. out of an intersection).

The following tables provide an overview of the current status (October 2015) of vehicle-borne alternative power supplies for light rail application.

**TABLE 1: Ground Level Power Supply Systems (GLPS)**

<table>
<thead>
<tr>
<th>City</th>
<th>Operational</th>
<th>Length, Off Wire</th>
<th>Length, System</th>
<th>Supplier</th>
<th>Technology</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bordeaux, France</td>
<td>2003</td>
<td>13.6 km segments</td>
<td>44 km, 90 stops, 3 lines</td>
<td>Alstom</td>
<td>APS</td>
<td>79 CITADIS vehicles</td>
</tr>
<tr>
<td>Angers, France</td>
<td>2011</td>
<td>1.5 km segments</td>
<td>12 km, 25 stops</td>
<td>Alstom</td>
<td>APS</td>
<td>17 CITADIS vehicles</td>
</tr>
<tr>
<td>Reims, France</td>
<td>2011</td>
<td>2 km segment</td>
<td>12 km, 23 stops</td>
<td>Alstom</td>
<td>APS</td>
<td>18 CITADIS vehicles</td>
</tr>
<tr>
<td>Orleans, France</td>
<td>2012</td>
<td>2.1 km segment</td>
<td>12 km, 26 stops, Line B</td>
<td>Alstom</td>
<td>APS</td>
<td>21 CITADIS vehicles</td>
</tr>
<tr>
<td>Tours, France</td>
<td>2013</td>
<td>2 km segment</td>
<td>15 km, 29 stops</td>
<td>Alstom</td>
<td>APS</td>
<td>21 CITADIS vehicles</td>
</tr>
<tr>
<td>Dubai Al Sufouh, UAE</td>
<td>2014</td>
<td>Completely catenary free</td>
<td>10.6 km, 11 stops</td>
<td>Alstom</td>
<td>APS II</td>
<td>11 CITADIS vehicles, 14 more in 2nd phase</td>
</tr>
<tr>
<td>Beijing, China</td>
<td>2015</td>
<td>4 km segments</td>
<td>9.4 km Xijiao Line</td>
<td>AnsaldoBreda / CNR</td>
<td>Tramwave</td>
<td>31 SIRIO vehicles</td>
</tr>
<tr>
<td>Zhuhai, China</td>
<td>2015</td>
<td>Completely catenary free</td>
<td>8.7 km, 14 stops</td>
<td>AnsaldoBreda / CNR</td>
<td>Tramwave</td>
<td>10 SIRIO vehicles</td>
</tr>
<tr>
<td>Cuenca, Ecuador</td>
<td>2016</td>
<td>1.2 km segment</td>
<td>10.5 km, 27 stops</td>
<td>Alstom</td>
<td>APS</td>
<td>14 CITADIS vehicles</td>
</tr>
<tr>
<td>Rio de Janeiro (Rio Porto Maravilha), Brazil</td>
<td>2016</td>
<td>Completely catenary free</td>
<td>28 km, 24 stops</td>
<td>Alstom</td>
<td>APS plus OESS (supercapacitors)</td>
<td>32 CITADIS vehicles</td>
</tr>
<tr>
<td>Lusail, Qatar</td>
<td>2018</td>
<td>22.7 km segments</td>
<td>33.1 km, 37 stops, 4 lines</td>
<td>Alstom</td>
<td>APS</td>
<td>35 CITADIS vehicles</td>
</tr>
<tr>
<td>Sydney, Australia</td>
<td>2019</td>
<td>1.5 km</td>
<td>12 km CBD/ East Line, 13 stations</td>
<td>Alstom</td>
<td>APS</td>
<td>30 CITADIS vehicles</td>
</tr>
<tr>
<td>Florence (Firenza), Italy</td>
<td>2017</td>
<td>470 m</td>
<td>7.5 km, 18 stops, Line 2</td>
<td>AnsaldoBreda</td>
<td>Tramwave</td>
<td>SIRIO vehicles</td>
</tr>
</tbody>
</table>

CURRENT STATUS WORLDWIDE
<table>
<thead>
<tr>
<th>City</th>
<th>Operational</th>
<th>Length, Off Wire</th>
<th>Length, System</th>
<th>Supplier</th>
<th>Technology</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nice, France</td>
<td>2007</td>
<td>0.91 km total segments</td>
<td>8.7 km, 21 stops</td>
<td>Alstom</td>
<td>Battery, (Ni-MH) (SAFT)</td>
<td>20 CITADIS vehicles</td>
</tr>
<tr>
<td>Seville, Spain</td>
<td>2011</td>
<td>0.6 km line segment</td>
<td>2.2 km, 5 stops</td>
<td>CAF</td>
<td>ACR Evodrive supercapacitors</td>
<td>4 URBOS 3 vehicles</td>
</tr>
<tr>
<td>Shenyang, China</td>
<td>2013</td>
<td>Segments totaling 2.5 km</td>
<td>69.9 km, 65 stops, 4 lines</td>
<td>CNR Changchun</td>
<td>Voith supercapacitors</td>
<td>30 'dolphin' vehicles</td>
</tr>
<tr>
<td>Zaragoza, Spain</td>
<td>2013</td>
<td>2 km off-wire segment, charging at stops</td>
<td>12.8 km, 25 stops</td>
<td>CAF</td>
<td>ACR Freedrive battery / supercapacitors</td>
<td>21 URBOS 3 vehicles</td>
</tr>
<tr>
<td>Guangzhou, China</td>
<td>2014</td>
<td>Completely catenary free, charging at stops</td>
<td>7.7 km, 10 stops, Haizu Circle Line</td>
<td>CSR ZELC</td>
<td>SIEMENS SITRAS ES supercapacitors (Maxwell)</td>
<td>7 vehicles</td>
</tr>
<tr>
<td>Nanjing, China</td>
<td>2014</td>
<td>90% catenary free, OCS only at stops and acceleration points</td>
<td>8 km, 13 stops, Hexi line</td>
<td>CSR Puzhen</td>
<td>Bombardier Primove battery (Li-ion)</td>
<td>15 FLEXITY 2 vehicles</td>
</tr>
<tr>
<td>Kaohsiung, Taiwan</td>
<td>2015</td>
<td>Completely catenary free, charging at stops</td>
<td>8.2 km, 14 stops</td>
<td>CAF</td>
<td>ACR Evodrive supercapacitors</td>
<td>9 URBOS vehicles</td>
</tr>
<tr>
<td>Dallas, TX</td>
<td>2015</td>
<td>Oak Cliff Streetcar, 1.6 km</td>
<td>2.6 km, 4 stops</td>
<td>Brookville</td>
<td>ABB battery (Li-ion nickel manganese cobalt)</td>
<td>2 LIBERTY vehicles</td>
</tr>
<tr>
<td>Konya, Turkey</td>
<td>2015</td>
<td>1.8 km</td>
<td>21 km, 35 stops</td>
<td>Skoda</td>
<td>CATFREE battery (nano-lithium-titanium)</td>
<td>12 FORCITY CLASSIC 28T vehicles</td>
</tr>
<tr>
<td>Santos, Brazil</td>
<td>2016</td>
<td>0.4 km</td>
<td>11.4 km, 14 stops</td>
<td>Vossloh</td>
<td>ABB battery (Li-titanate)</td>
<td>22 TRAMLINK V4 vehicles</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>2016</td>
<td>Seattle First-Hill Streetcar, 4 km (downhill track)</td>
<td>4 km, 10 stops</td>
<td>Inekon</td>
<td>Battery (Li-ion)(SAFT)</td>
<td>6 TRIO 12 vehicles</td>
</tr>
<tr>
<td>Detroit, MI</td>
<td>2016</td>
<td>New M-1 streetcar line, (length tbd - 60% of system proposed)</td>
<td>5.1 km, 20 stops</td>
<td>Brookville</td>
<td>ABB battery (Li-ion nickel manganese cobalt)</td>
<td>6 LIBERTY 12 vehicles</td>
</tr>
<tr>
<td>Doha Education City, Qatar</td>
<td>2016</td>
<td>Completely catenary free, charging at stops</td>
<td>11.5 km, 25 stops</td>
<td>Siemens</td>
<td>SITRAS HES battery (Ni-MH) / supercapacitors</td>
<td>19 AVENIO vehicles</td>
</tr>
<tr>
<td>Granada, Spain</td>
<td>2017</td>
<td>4 segments totaling 4.95 km</td>
<td>15.9 km, 26 stops</td>
<td>CAF</td>
<td>ACR Freedrive battery / supercapacitors</td>
<td>13 URBOS 3 vehicles</td>
</tr>
<tr>
<td>Luxembour, Luxembourg</td>
<td>2020</td>
<td>3.6 km off-wire segment between Pont Rouge and Gare Centrale, charging at stops</td>
<td>16 km, 24 stops</td>
<td>CAF</td>
<td>ACR Freedrive battery / supercapacitors</td>
<td>21 URBOS 3 vehicles</td>
</tr>
<tr>
<td>Nice</td>
<td>2018</td>
<td>Completely catenary free, charging at stops</td>
<td>11.3 km</td>
<td>Alstom</td>
<td>SRS with Ecopack (battery / supercapacitors)</td>
<td>19 Citadis XO5 vehicles</td>
</tr>
<tr>
<td>Munich, Germany</td>
<td>2019</td>
<td>Planned English Garden extension, 1 km with 2 stops</td>
<td>8 km, 4 new stops</td>
<td>Stadler</td>
<td>Battery (Li-ion)</td>
<td>4 VARIOBAHN vehicles with batteries ordered (w/ 10 more pre-wired for future battery retrofit) All delivered, but only one vehicle currently fitted with batteries pending construction of new line.</td>
</tr>
</tbody>
</table>

**TABLE 2: On-Board Energy Storage Systems for Off-Wire Operation (OESS)**
TABLE 3: Diesel Hybrid (Tram Train) Vehicles for Off Wire Operation (OPGS)

<table>
<thead>
<tr>
<th>City</th>
<th>Operational</th>
<th>Length, Off Wire</th>
<th>Length, System</th>
<th>Supplier</th>
<th>Technology</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nordhausen, Germany</td>
<td>2004</td>
<td>8 km</td>
<td>9 km, 5 stops, Line 10</td>
<td>Siemens</td>
<td>Diesel hybrid</td>
<td>3 COMBINO DUO tram train vehicles</td>
</tr>
<tr>
<td>Kassel, Germany</td>
<td>2006</td>
<td>28 km</td>
<td>30 km, 27 stops, Line RT4</td>
<td>Alstom</td>
<td>Diesel hybrid</td>
<td>10 REGIOCITADIS tram train vehicles</td>
</tr>
<tr>
<td>Leon, Spain</td>
<td>2011</td>
<td>New FEVE tram train route Leon - Cistiernia</td>
<td>24 km</td>
<td>Vossloh</td>
<td>Diesel hybrid</td>
<td>4 TRAMLINK tram train vehicles</td>
</tr>
<tr>
<td>Chemnitz, Germany</td>
<td>2014</td>
<td>Three new tram train lines to Burgstädt, Mittweida and Hainichen</td>
<td></td>
<td>Vossloh</td>
<td>Diesel hybrid</td>
<td>8 CITYLINK tram train vehicles</td>
</tr>
</tbody>
</table>

Zaragoza, Spain - 2 km off-wire segment using onboard energy storage, opened 2013
<table>
<thead>
<tr>
<th>Installer</th>
<th>Operational</th>
<th>Location</th>
<th>Supplier</th>
<th>Technology</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alstom</td>
<td>1999</td>
<td>La Rochelle, France, Alstom Test Track</td>
<td>Alstom</td>
<td>Magnet Motor flywheel</td>
<td>CITADIS vehicle, STARS program. First use of charging at station stops</td>
</tr>
<tr>
<td>Alstom</td>
<td>2001</td>
<td>Karlsruhe, Germany Line 1</td>
<td>Duewag</td>
<td>Turbomeca microturbine hybrid with CCM EMAFER flywheel energy storage</td>
<td>Ex - VBK GT8 vehicle, ULEV-TAP (Ultra Low Emission Vehicle - Transport using Advanced Propulsion) program.</td>
</tr>
<tr>
<td>Spie-Enertrans</td>
<td>2001</td>
<td>Marseille, France Line 68</td>
<td>La Brugaise</td>
<td>Innorail ground contact system</td>
<td>RTM PCC vehicle</td>
</tr>
<tr>
<td>Alstom</td>
<td>2002</td>
<td>La Rochelle, France, Alstom Test Track</td>
<td>Alstom</td>
<td>Innorail / APS ground contact system</td>
<td>CITADIS vehicle</td>
</tr>
<tr>
<td>Bombardier</td>
<td>2003-2007</td>
<td>Mannheim, Germany</td>
<td>Bombardier</td>
<td>MITRAC Energy Saver supercapacitors</td>
<td>DUWAG GTN6 vehicle</td>
</tr>
<tr>
<td>Siemens</td>
<td>2003-2005</td>
<td>Karlsruhe, Germany</td>
<td>Siemens</td>
<td>Diesel hybrid with 2 CCM flywheel energy storage units</td>
<td>AVANTO / S70 vehicle, ULEV-TAP 2 program.</td>
</tr>
<tr>
<td>Alstom</td>
<td>2006-2008</td>
<td>Rotterdam, Netherlands</td>
<td>Alstom</td>
<td>CCM flywheel</td>
<td>CITADIS vehicle, ULEV program</td>
</tr>
<tr>
<td>Kawasaki</td>
<td>2007-2008</td>
<td>Sapporo, Japan</td>
<td>Kawasaki</td>
<td>Gigacell battery (Ni-MH)</td>
<td>SWIMO-X demonstrator vehicle, RTRI sponsorship</td>
</tr>
<tr>
<td>Siemens</td>
<td>2007</td>
<td>Lisbon (Almada), Portugal</td>
<td>Siemens</td>
<td>SITRAS HES (energy saver) battery / supercap.</td>
<td>COMBINO PLUS vehicle</td>
</tr>
<tr>
<td>Tokyo Car</td>
<td>2007-2008</td>
<td>Sapporo, Japan</td>
<td>Tokyo Car</td>
<td>Battery (Li-ion)</td>
<td>HI-TRAM demonstrator vehicle, RTRI sponsorship</td>
</tr>
<tr>
<td>Alstom</td>
<td>2009-2010</td>
<td>Paris, France</td>
<td>Alstom</td>
<td>ECOPAK Supercapacitors</td>
<td>CITADIS vehicle, STEEM program</td>
</tr>
<tr>
<td>AnsaldoBreda</td>
<td>2010</td>
<td>Naples, Italy, 0.4 km test track and 0.6 km Poggioreale-Via Stadera line</td>
<td>AnsaldoBreda</td>
<td>Tramwave ground contact system (2nd generation STREAM)</td>
<td>SIRIO vehicle</td>
</tr>
<tr>
<td>Stadler</td>
<td>2011</td>
<td>Velten, Germany test track</td>
<td>Stadler</td>
<td>Battery (Li-ion)</td>
<td>VARIOBAHN vehicle from MVG Munich order. One of four to be used on a future catenary free line through English Garden.</td>
</tr>
<tr>
<td>Bombardier</td>
<td>2011-2012</td>
<td>Augsburg, Germany, 0.8 km Prinmove test track</td>
<td>Bombardier</td>
<td>Primove (inductive) current collector / battery</td>
<td>VARIOBAHN test vehicle</td>
</tr>
<tr>
<td>Fenix Rail</td>
<td>2011</td>
<td>Valencia, Spain</td>
<td>Fenix Rail</td>
<td>Fuel cell (hydrogen) / battery (Li-ion) / supercapacitors</td>
<td>Ex-SNCV FABIOLOS 3400 series vehicle, supported by local government funds.</td>
</tr>
<tr>
<td>KinkiSharyo</td>
<td>2011</td>
<td>Various US cities</td>
<td>KinkiSharyo</td>
<td>Battery (Li-ion)</td>
<td>AMERITRAM demonstrator vehicle,</td>
</tr>
<tr>
<td>AnsaldoBreda</td>
<td>2012</td>
<td>Florence (Firenza), Italy</td>
<td>AnsaldoBreda</td>
<td>Supercapacitors</td>
<td>SIRIO vehicle</td>
</tr>
<tr>
<td>AnsaldoBreda</td>
<td>2012</td>
<td>Bergamo, Italy</td>
<td>AnsaldoBreda</td>
<td>Supercapacitors</td>
<td>SIRIO vehicle</td>
</tr>
<tr>
<td>Hyundai Rotem / KRRI / KAIST</td>
<td>2007-2014</td>
<td>Gyeonggi-do, Korea</td>
<td>Hyundai Rotem</td>
<td>Battery (Li-ion) / OLEV power transfer system</td>
<td>WTRAM prototype vehicle’ Korea Railroad Research Institute. OLEV system Korea Advanced Institute of Science &amp; Technology.</td>
</tr>
<tr>
<td>Vossloh</td>
<td>2013</td>
<td>Valencia, Spain</td>
<td>Vossloh</td>
<td>Battery (Li-ion)</td>
<td>TRAMLINK vehicle</td>
</tr>
<tr>
<td>Siemens</td>
<td>2014</td>
<td>San Diego, CA</td>
<td>Siemens</td>
<td>Battery (Li-ion)</td>
<td>S70 vehicle, World record distance off wire (24.6 km)</td>
</tr>
<tr>
<td>CSR</td>
<td>2014</td>
<td>CSR China</td>
<td>CSR</td>
<td>Supercapacitors</td>
<td>4 module prototype vehicle</td>
</tr>
<tr>
<td>CAF</td>
<td>2015</td>
<td>Vitoria-Gasteiz, Spain</td>
<td>CAF</td>
<td>Battery (Li-ion)</td>
<td>URBOS 2 vehicle, OSRIS project</td>
</tr>
<tr>
<td>Born Sinal (Vossloh VLT licensee)</td>
<td>2015</td>
<td>Brazil</td>
<td>Born Sinal</td>
<td>Battery</td>
<td>TRAMLINK VLT based vehicle, CPDM-VE project.</td>
</tr>
<tr>
<td>CSR Sifang (Skoda licensee)</td>
<td>2015</td>
<td>Quingdao, China</td>
<td>CSR Sifang</td>
<td>BALLARD FCvelocity fuel cell (hydrogen)</td>
<td>ASTRA 1ST vehicle</td>
</tr>
<tr>
<td>Pesa</td>
<td>2015</td>
<td>Krakow, Poland</td>
<td>Pesa</td>
<td>Supercapacitors</td>
<td>SOLARIS TRAMINO vehicle</td>
</tr>
<tr>
<td>Toshiba</td>
<td>2015</td>
<td>Kagoshima, Japan</td>
<td>Aina Sharyo</td>
<td>Toshiba SCiB compact battery (Li-ion)</td>
<td>LITTLE DANCER Type A3 vehicle.</td>
</tr>
</tbody>
</table>
### TABLE 5: On Board Energy Storage for Energy Savings

In addition to numerous prototype vehicles used for evaluating onboard energy storage systems for energy savings (reference Table 4), the following light rail vehicles are known to have been fitted with such systems for commercial use. This list is not comprehensive and further research will be required to compile a more complete list.

<table>
<thead>
<tr>
<th>City</th>
<th>Year operational</th>
<th>Area of Operation</th>
<th>Supplier</th>
<th>Technology</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland, Oregon</td>
<td>2012</td>
<td>TriMet system</td>
<td>American Maglev</td>
<td>Supercapacitors (Maxwell)</td>
<td>27 SD660 vehicles retrofitted under TIGGER III grant</td>
</tr>
<tr>
<td>Rhine-Neckar, Germany</td>
<td>2012</td>
<td>Mannheim to Heidelberg Line</td>
<td>Stadler</td>
<td>Bombardier MITRAC Energy Saver supercapacitors</td>
<td>30 VARIOBAHN vehicles</td>
</tr>
<tr>
<td>Rostock, Germany</td>
<td>2014</td>
<td></td>
<td>Vossloh</td>
<td>Vossloh Kiepe supercapacitors</td>
<td>13 TRAMLINK 6N2 vehicles</td>
</tr>
<tr>
<td>Seattle, WA</td>
<td>2014</td>
<td>Sound Transit LINK LRT System</td>
<td>KinkiSharyo</td>
<td>Supercapacitors</td>
<td>3 existing 1500 VDC KinkiSharyo LRVs retrofitted under TIGGER grant</td>
</tr>
<tr>
<td>Cuiaba, Brazil</td>
<td>2015</td>
<td></td>
<td>CAF</td>
<td>ACR Evodrive supercapacitors</td>
<td>40 URBOS 3 vehicles</td>
</tr>
<tr>
<td>Wroclaw, Poland</td>
<td>2015</td>
<td></td>
<td>Pesa</td>
<td>Supercapacitors</td>
<td>6 TWIST vehicles</td>
</tr>
</tbody>
</table>
The last five years has seen increasing interest in unconventional means of propulsion throughout the transportation sector. For road transport vehicles, electric drives have become more and more commonplace. The battery, supercapacitor, flywheel and fuel cell technology needed to power these electric drives has advanced considerably, with more efficient, smaller, lighter and cost effective designs becoming commercially available, along with increasing modularity, a trend that is expected to continue.

Although the automotive sector is clearly driving development of onboard power sources, it is interesting to note that of all the vehicles used to transport people today, the modern light rail vehicle has for some while been perhaps the best candidate for their use, as they were already electrically propelled and have had the ability to regenerate braking energy as a standard feature. Market factors, such as low production quantities, cost, space requirements, weight and complexity, as well as the inherent conservatism of the rail vehicle marketplace where vehicles and their systems are typically expected to last 30 or more years, have initially slowed progress in this direction, but that is now changing.

The use of energy storage (both wayside and onboard) to achieve energy savings continues to grow, particularly in Europe where higher energy costs provide increased incentive. As a result, numerous projects have reported out their analyses for calculating return on investment (e.g. calculating payback period). As a result of these studies, significant discussion on the subject of new vs. retrofit of alternative power supplies has also emerged. Feedback from the carbuilders, combined with numerous studies, indicate that it is far more efficient to design in energy storage equipment from the beginning than to retrofit it. Fewer components and cleaner interfaces, less weight, standardized elements, all combine to reduce cost and thus shorten the return on investment period.

The following sections review the most significant advances for the three primary types of alternative power supply technologies for light rail applications.

GROUND LEVEL POWER SUPPLY (GLPS)

Background

The modern quest for “wire free” zones for light rail systems began in 1999 when the ancient city of Bordeaux, France wanted to build a new system that traversed an historically important area containing their 13th century cathedral and crossed an historic bridge over the Garonne without the use of overhead wires. It was not until 2003 that the first 3 km GLPS segments of the system opened, but today more than 31 km are in commercial service worldwide, with more on the way.

This initial approach to providing off-wire capability concentrated on providing continuous ground level power to the vehicle, either via a switched direct contact system, such as APS or TramWave or an inductive power transfer system such as Primove or OLEV Power Track. The continuous power supply approach is particularly advantageous in extreme climates where heavy duty heating and air conditioning is required, and for alignment sections with steep up-hill gradients where onboard energy storage systems are quickly drained. As seen in Table 1, the APS system is the most mature, having been through many teething problems to become very reliable and is now the market leader for ground level power supply. Other ground level systems are generally less well proven, but they are also now beginning to attract buyers. The suitability of GLPS in climates with heavy snowfall (and the attendant use of plows and road salt for snow removal) also remains an open question.

Issues

In all GLPS installations to date, a single supplier has provided both the vehicles and the power distribution infrastructure. While this system-level approach is logical, the proprietary nature raises commercial issues that represent one of the biggest hurdles to the wider adoption of such systems. In the US, sole source procurements of this nature are difficult to support under FTA procurement guidelines and longer term, it locks an agency into a single technology and a single vehicle type from a single supplier, which carries some level of uncertainty regarding future support and further development.
There are indications that some suppliers are willing to supply the GLPS system separate from the vehicle, but there have been no applications of this approach to date and the power transfer system itself still remains a proprietary, sole source system.

The closely related issue of costs for GLPS has also been a significant factor. The initial APS system installation was said to be 8 times as expensive as traditional OCS. Even though that price reflected significant engineering and development costs for the relatively short length of APS equipped track (3 km), no specific pricing data is available today, and so it seems clear that GLPS remains an expensive solution. In the opinion of the authors, it is perhaps possible that GLPS systems are best suited to supply as part of “turnkey” packages that offer the supplier the ability to provide vehicles and infrastructure as a package together with long term maintenance.

This approach could help optimize risk sharing and spread the costs over a wider scope of supply, preserving necessary margins for the supplier while still offering the customer value for money.

**Advances**

The high costs of the complex underground infrastructure associated with GLPS has led suppliers to propose various non-continuous solutions in the last few years. Although continuous GLPS systems already utilize an onboard battery for limited use in working around segment outages, adding a more robust onboard energy package provides two significant advantages; chiefly the potential to simplify the infrastructure by limiting the use of the expensive ground power supply system components to locations where it is convenient for charging (e.g. at stops), or needed for demanding power use (e.g. accelerating zone out of stops, hills, etc.), thus making the system more affordable. And in the case of APS, this would also offer the potential to utilize regenerative energy from braking, which is not possible with the current generation of this technology. An example of this migration is found in the new tramway system currently under build in Rio de Janeiro, which will utilize supercapacitor-based energy storage on the vehicles in combination with Alstom APS ground level supply. An Alstom press release states that the system is completely catenary free, but the APS ground power supply will only be installed over 80% of the system.

**ONBOARD ENERGY STORAGE (OESS)**

**Background**

As the first GLPS system was going into service in 2003, efforts were also being made to provide vehicle power by use of OESS based on battery, supercapacitor and flywheel technology. Initial experiments focused on achieving energy savings through increased recuperation of regenerated braking energy, with off-wire operation a natural outgrowth. Nice, France was the first city to introduce commercial off-wire operation using OESS, debuting in 2007 with two short segments.

**Issues**

From an operational perspective, the most significant trade-offs of the OESS approach to off-wire center around the fact that it is not a continuous form of power supply. The energy storage units need to be periodically recharged, and vehicle performance restrictions are typically implemented as part of optimizing the amount of energy storage to be carried on the vehicle. One example is “load shedding” which is relatively straight-forward from a technical perspective, although its impact on operations is less clear. A good example would be reducing air conditioning in a scenario where a vehicle has become stuck in traffic- advantageous from an energy conservation point of view, but perhaps unacceptable from a customer service perspective in hot climates. In the end, careful design is required to find the optimal balance between energy storage capacity and the associated weight and space requirements. The additional equipment required to integrate the OESS also adds a further degree of technical complexity to the vehicle.

How charging is achieved also depends on the system design – if only short off-wire segments are to be traversed, then charging via the OCS is often a workable approach. However if it is desired to have an extended off-wire section, or even a completely “catenary free” system, then it is necessary to recharge by other means, usually at station stops via either a conventional pantograph and an overhead conductor, or via a ground level pick-up or inductive charging system. This overhead “charging station” approach using modified pantographs has now been applied to new systems in Guangzhou, Kaohsiung, Nanjing and Doha Education City.
This has the advantage of being very straightforward and non-proprietary. Reliability can be improved by incorporating an automatic location system to raise and lower the pantograph in the right places.

Another operational issue has to do with the inherent hazards associated with onboard energy storage. Maintenance practices will be impacted by the presence on the vehicle of what in many cases is effectively a constantly charged power source. Additionally, the prevailing use of Li-Ion type batteries requires a significantly different level of care than battery technologies such as lead acid or NiCad commonly used on many types of rail vehicles.

From a cost perspective, the most significant trade-off inherent in the OESS approach is the initial impact on vehicle capital costs and the life cycle cost of periodic replacement of the onboard energy storage units. Although detailed, unbiased cost information is generally not available (in common with other forms of alternative power supply) it is clear that the system operator will need to make significant allowances for ongoing renewals throughout the life of the vehicle, although as the technology improves, the time between upgrades may continue to increase, and the costs reduce.

Advances

Advances in the area of OESS center around the continuing evolution of the energy storage units themselves. Of these, batteries (usually lithium-ion) and supercapacitors (or a combination of the two) have enjoyed the greatest success so far, but continuing development of high tech flywheel technology (such as the GKN / Williams Hybrid Power MLC flywheel units) may well see their widespread use. An added advantage to all of these technologies is that they are supported by the world automotive market, where there is considerable research and development. Further, with careful design, it is also possible to utilize OESS to achieve energy savings through improved capture of regenerative braking energy, offering the potential for new systems to realize a reduction in the number of substations, or for an existing system to add service or transition to a modern fleet with limited upgrading of the power network.

OESS systems with periodic charging are currently one of the most promising and widely available approaches available for those seeking an end to overhead wires. It will be interesting to see how the inherent trade-offs are dealt with once the new crop of systems becomes fully operational, particularly in cities with extreme climates where power demand from vehicle HVAC systems is significant.

ONBOARD POWER GENERATION (OPGS)

Background/Issues

The OPGS approach to alternative power supply has been the slowest to develop, seeing more modest commercial application than GLPS and OESS. Advances have however been made in various approaches to fueled power generators on the vehicle. The trade-offs involve impacts on vehicle weight and configuration due to the related space impacts arising from both the power generator and the associated fuel storage / refueling facilities required.

In 2004, a small fleet of trams in Nordhausen Germany was locally fitted with a motor-generator package based on automotive diesel engines. Other European suppliers have followed a similar approach for light rail vehicles that needed to operate on both existing electrified lines within the city center and travel out to neighboring cities on existing regional rail lines without the expense of electrifying the entire line. Known in Europe as “tram-trains”, these vehicles are most commonly straight electric with dual voltage capabilities, but the diesel hybrid type has now also carved out a niche for itself, although it remains a limited market.

Advances

The most significant progress relating to onboard power generation involves the hydrogen fuel cell. It has been predicted that 2015 will be the year of the fuel cell and that appears to be true. Toyota has announced the first production series fuel cell cars will be built this year and at least two fuel cell development light rail vehicles are under evaluation. Alstom has selected Hydrogenics to provide fuel cells for regional trains, while the CSR LRV and other rail vehicle demonstrators use Ballard and no doubt other light rail versions are under development. Costs are still high for the fuel cell units and hydrogen supplies are not yet widely available, but this technology looks to be the wave of the future.
As noted earlier, the application of alternative power supplies to any light rail system requires a detailed system-specific approach and full consideration of all the variables involved in order to select the right technology and to optimize the size of the energy storage elements involved to provide the most cost effective solution. This is far from being a simple task – as a minimum, the following variables will affect the analysis and design process for both GLPS and OESS systems:

**Duty Cycle**
- Operating headways (initial and future)
- Operating consists (single car, multiple cars)(initial and future)
- Distance between stops (off wire)
- Dwell times at stops (off wire)
- Dwell time at turnarounds (under OCS)
- Operating time / distances under OCS

**Alignment**
- Alignment curvature and gradients (off wire)
- Track arrangement (single track, double track, passing loop, crossing, junction, etc.)(off wire)
- Level of priority at traffic lights (none, predictive, priority)
- Number of road crossings between station stops (off-wire)
- Degree of operation shared with road vehicles
- Local speed limits
- Availability of space for wayside sub-stations, power feeders, etc.
- Future system expansions (including any off-wire sections)

**Operating Environment**
- Temperature dependent vehicle loads (heating and air conditioning)
- Local climactic conditions (ice, snow, extreme heat)
- System regeneration limitations (line receptivity, regen initiation voltage, maximum regen voltage)
- Energy costs and contractual arrangements (including peak demand charges, etc.)

**Vehicle Systems**
- Space available on board vehicles
- Capacity, recharge time, size, weight and cost of energy storage elements

Similar operational, alignment and climactic requirements also apply to OPGS, as well as:
- Capacity, size, weight and cost of onboard power generation elements
- Capacity, size, weight and cost of fuel storage elements
- Cost and availability of selected fuel
- Refueling periodicity / refill time
- Wayside refueling equipment requirements
- Cooling, exhaust, monitoring, control, maintenance approach
- Fire detection / prevention / containment considerations
- Noise / vibration mitigation

Given all these variables, there is a need for more advanced simulation tools that will allow the designer to input and adjust the various parameters to obtain an optimal solution.

Doha, Qatar - 11.5 km catenary-free line, using onboard energy storage with recharging at each station. Opening 2016
Alternative power supply methods for light rail are entering a new phase of development, offering system designers an important new tool in the toolbox. Compared to ten years ago, there are now a significantly larger number of ‘early adopter’ systems either in commercial service or under construction. While that number is still small compared to the over 400 light rail systems worldwide, interest is strong and the experience gained in operating these systems is expected to facilitate further improvements and to start helping to answer the significant questions concerning life cycle costs. In parallel with the evolution of alternative power systems for light rail vehicles, there is automobiles and other forms of road transport (including electric transit buses) are seeing.

Issues impacting the application and development of alternative power supply to light rail include:

1. From a commercial perspective, proprietary technology issues remain a significant point, particularly for ground power systems which involve significant equipment on the wayside. Ultimately, buyers want a mature (service proven) technology that conforms to agreed industry standards, allowing designers to select from a range of competing suppliers. At this time the relatively new field of alternative power supply is not in this position; it has limited standards and a series of competing, highly customized designs.

   Decision makers have relatively little hard data on capital and life cycle costs for GLPS and OESS. Given the relative newness of the technology, the small quantities involved, and the competing proprietary designs, it may not be practical to expect that detailed, unbiased cost data will be available anytime soon. Instead, it may be necessary to consider technologies such as GLPS only within a project delivery framework that allows a single supplier to provide the vehicles, related infrastructure and long-term maintenance as part of a turnkey package, thus providing an opportunity to better allocate risks associated with capital and life cycle costs.

   Together with standards covering key related topics (e.g. safety measures for use of Li-Ion batteries on light rail vehicles), both the suppliers and the buyer will be in a better position to continue developing alternative power supplies for light rail.

2. From a project design perspective, application of alternative power supply technologies remains very project specific and may require vehicle performance tradeoffs, particularly with OESS. Its design is an iterative process that requires careful analysis of alignment and duty cycle, including local climate factors in order to balance the amount of energy storage capacity with the associated weight, space and performance tradeoffs. Given the significant impacts on multiple aspects of project design, balancing the need for an early commitment to off-wire operation (e.g. in the environmental phase) with traditional project design approaches may be challenging.

   There is also a need for more sophisticated tools to properly analyze the various system characteristics and consider a variety of scenarios in order to arrive at a reliable, cost effective off-wire system design.

3. Onboard energy storage has multiple uses; its application began with a desire for energy savings by increased recuperation of regenerative braking energy, and has expanded into the ability to provide off-wire operation.

4. Although hydrogen fuel cell powered vehicles hold great promise for the future, currently the most economical and straightforward approach to off-wire operation is onboard energy storage with periodic recharging. Recharging can be at station stops, or combined with recharging under wired sections of the alignment. To operate such a system reliably, it seems likely that automating the recharging process, rather than relying on manual human actions will be required.

5. From a project planning perspective, the implications of including a commitment to off-wire operation in a project’s environmental documentation, and then later altering the approach based on further refinement of project costs and objectives, remains unclear.
1. What industry R&D process changes could further speed up / improve development? What tools are needed to more efficiently analyze requirements?

2. New vs. retrofit- what are the economics of buying a light rail vehicle as “off wire capable”, meaning effective steps to facilitate the future addition of this capability? Besides reserving physical space, what other design elements need to be considered?

3. Related to the above question, what new standards, or changes to existing standards, may be needed to facilitate application of these technologies and to ultimately lessen the impacts of proprietary technology?

4. Design issues associated with frequent charging (e.g. at stops). These may include having to raise and lower the power transfer element – having the operator do this leaves a high likelihood of human error, while an automated system adds complexity and cost, but increases system reliability. For systems with a mixture of conventional OCS and off-wire operation, are their conflicting requirements related to pantograph design? Other related design issues include power distribution for “charging stations”, centering around the trade-offs between centralized substations feeding the charging points, versus localized power conversion equipment at each point.
Authors

John Swanson
Interfleet Technology Inc.
(760) 840 7433
Smatlak.j@interfleetinc.com

John Smatlak
Interfleet Technology Inc.
(213) 219 6128
Swanson.j@interfleetinc.com
April 24, 2019

Dear Dr. Dykaar:

We understand you and Barrow Emerson are working on the scope of the Alternatives Analysis. When considering alternatives for high capacity public transit on the rail corridor right of way, our community deserves a comprehensive triple bottom line analysis of this decision considering Social Equity, Environmental Impact, and Economic Viability. We believe this TBL approach will clearly identify the very best high capacity public transit use of the existing rail corridor. Consistent with this, the Friends of the Rail & Trail have been giving this question serious consideration for many years and would like to share our thoughts with you.

The decision for selecting a high capacity public transit solution for use in the existing rail corridor should address the following:

- be **equitable** for people throughout the county
- be **convenient** enough to supplant car trips for the most people possible
- be the most economically efficient - **lowest operating cost** per rider-mile
- be environmentally efficient - use the **least energy** per rider-mile
- be the most **reliable** solution possible, regardless of traffic or weather
- be easily **accessible** for the handicapped - **roll on, roll off**
- be able to carry large numbers of **bicycles** (based on SMART experience)
- be able to be implemented as **quickly** as possible
- be **competitive** for State and Federal funding
- have **minimum environmental impact**, both in creation and operation
- have the lowest **greenhouse gas emissions** per rider-mile
- have the **capacity and capability to scale** up easily as ridership grows
- provide the best **travel times** for the most riders, including intermodal trips
- provide the best **synergy** to address first/last mile challenges (bike/bus/board)
- **integrate** with statewide transit system, current and planned
- **satisfy all STB requirements** for approval of a transportation project on corridor
- **maximize VMT reduction** in the County
- **coordinate well** with other public services like bus and paratransit
- **preserve the easements** that allow us to use the ROW
- augment and accelerate the construction of a **safe bike and pedestrian trail**

Our research over the past decade indicates that the most likely modality is going to be some form of electric light rail, with a distinct possibility of it being battery powered. We have always been fact-driven, and as such we are open to other possibilities in the event that they can achieve the above bullet points better than a rail solution, but at this point we consider the burden of proof to be on other modalities.

Signed,

Sally Arnold,
FORT Board Chair
Santa Cruz County Regional Transportation Commission  
1523 Pacific Avenue  
Santa Cruz, CA  95060  

June 25, 2019  

RE: Agenda Item 18 (6/27/19 RTC) – Alternatives Analysis for High Capacity Public Transit on the Rail Right-of-Way  

Dear Chair Bottorff, Commissioners and Staff –  

Thank you for the opportunity to comment on this agenda item that is so important for the future of our coastal communities.  

Regarding the staff report, does the staff recommendation intend for the Commission to authorize that the draft Scope of Work, as it may be amended by the Commission, to be included in the Request for Proposals for consultant services, and to authorize release of the RFP? The proposed timeline presumes that the Metro Board will also act to authorize release of the RFP for this $650,000 study; how will potential differences in the resulting draft Scope of Work documents be resolved prior to releasing the RFP on July 2?  

Regarding the draft Scope of Work:  

Page 18-5: Under “overall project objectives”, first bullet, what is meant by the reference “for 2035”?  

Page 18-5, Bullet 2: Please revise to read “Serve existing and new transit users along and between urbanized area locations near the rail line from Watsonville to Santa Cruz.”  

Page 18-5, Bullet 5: Please add “environmental benefits” and “social equity considerations” to the list of identified performance measures.  

Page 18-5, Bullet 10: Please revise to read “Identify opportunities to enhance high-capacity transit investment via strategically located transit-oriented land development in urbanized areas.”  

Page 18-6: The map in Exhibit 1 highlights only areas that are within city limits; it should show all urbanized areas within the county, incorporated and unincorporated.  

Page 18-6, Task 1.1 Project Kick Off Meeting: Please delete or move the last sentence referring to value engineering (Task 6), as it is not pertinent to the Kick Off Meeting.
Page 18-7, Deliverables 2.1.1: Please revise to read “List and summarize studies reviewed insofar as they inform goals and objectives, performance measures, and other pertinent aspects of the current analysis.

Page 18-9, 10, Task 3.3: It seems like it would be helpful in this section to highlight the Commission/Metro’s expectations about how travel demand model assumptions and results for this analysis will differ from the version recently compiled and used for the Unified Corridor Investment Study. Also, Bullet 7 in the list of considerations is a suggested outcome, not a consideration, and should be deleted from the list or moved elsewhere.

Page 18-11, Task 4 Assess Metro Funding Through 2045: This task does not seem relevant to the analysis as written. Wouldn’t it make more sense to assess the full transit funding picture in order to inform the cost/revenue aspect of the study?

Page 18-11, Task 5.1 and elsewhere: Please replace “passenger rail” with “rail transit” throughout the document.

Page 18-13, Task 5.6: Please consider joint meetings of the RTC and Metro Boards at critical points during the study’s progress. This partnership would be helpful for the Boards, their staff, and members of the public, and would also serve to highlight the overlap of officials who sit on both Boards.

Page 18-13, Task 6.1: Paragraph three seems to confuse the directive for value engineering with development of alternative operating scenarios. Value engineering should follow alternatives development and performance measure analysis, not the other way around.

Finally, it seems like this draft Scope of Work would benefit from additional review and refinement prior to solicitation of consultant responses. Is there something driving the tight timeline? Also, presumably Metro is contributing financially to this study – please clarify.

Thank you very much for considering these comments.

Sincerely,

[Signature]

Linda Wilshusen
SCCRTC Executive Director 1985-2005
From: Joanna Miller <millersdaughter@me.com>  
Sent: Tuesday, June 25, 2019 10:45 PM  
To: Regional Transportation Commission <info@sccrtc.org>  
Subject: “RTC 6/27/19 item 18 Alternatives Analysis” Rail Trail

Hello,

I am one of the Davenport Warehouse owners.

I am sure that the best use of the transportation system is to bring in the train. Don’t change it. Having a safe way home for people who are coming to Davenport for lunch, for the beach, maybe a few beers or wine tasting at Bonny Doon Tasting Room. They get to return if they prefer to on the track system that is historic. Probably better ventilation also. Wind in your hair! The train will be something that will not add to highway traffic, and be a fun experience for the family. It also could be a great way to use the Rail for a rainy day outing.

The tradition of train travel. The history of lumbering and agriculture on the coast could be told by using some old designs from the early businesses. I have seen the FOG BELT brand for produce. Cara Mia Artichokes were local. We have the opportunity to do something really special with this coastal access. Making the coastal experience more than just a ride up the coast for a day at the Beach or a hike at the new national Monument in Davenport when that is resolved.

I have friends with back yard trains. One who is designing something for the skunk train in Mendocino right now. Eventually one could add train cars if we find it is popular. It is a great way for mobility impaired visitors to feel like that can experience the coast rail. I also love the Rail Explorers little Rail bikes for Mobility impaired also.

The beauty of the train is that it may be something that changes, improves over time as need be. The adding of train cars and env a dinner ride, a sunset ride. so much more than a buss and much better aesthetics. And no need for a big Bus Parking space and turn around.

I am looking forward to riding the Rail Explorers again and hoping to have the Rail experience... even going to Santa Cruz to pick up groceries!

Please let us have a bit of beautiful history for transportation.

Joanna Miller
June 25, 2019

Dear Commissioners,

The proposed scope of work for the Alternatives Analysis (AA) is lacking in several important respects and could be substantially improved before it is approved.

While the proposal does a bang up job on the issues of ridership and money, the scope does not adequately address the environmental and social equity issues so important to our community. This is particularly alarming because the 2040 Regional Transportation Plan (RTP) adopted just last year, focuses on sustainability using a Triple Bottom Line (TBL) analysis framework as the foundation for transportation decisions going forward. TBL requires consideration of people, planet and prosperity. In fact, Chapter 1 of the RTP is titled “Why Sustainability” and Chapter 4 of the RTP opens with the following paragraph:

The Santa Cruz County Regional Transportation Plan (2040 RTP), through its goals and policies, sets forth a foundation for expanding options for residents and visitors to access their daily needs in a way that is safe, equitable, protects the environment and promotes investment in the local economy. This is advanced by designing and implementing a transportation system that serves our diverse travel needs and embraces the principle that transportation is intertwined with environmental, economic and social concerns.

Barely mentioning 2 of the 3 foundational policy elements (people and planet) as you consider making the single most important decision about the future of our transportation system is troubling, and we hope merely an unintentional oversight. Making such a decision without adequately evaluating the environment and social equity will not lead to the best possible decision. This decision is about much more than cash flow!

The proposed AA scope also includes the following task:

Task 4 Assess METRO funding through 2045. Consultant will assess METRO capital and operating funding capacity through 2045 by consulting the AMBAG MTP/SCS, the SCCRTC RTP, and the UCS and reviewing Federal and State funding opportunities that are realistically available to METRO.

Expending Measure D funds allocated to the Rail Corridor for assessing future METRO funding appears to be an inappropriate use of those funds. As you know, METRO received 16% of Measure D funds while the rail corridor received only 8%. Spending rail corridor funds to support METRO is clearly inconsistent with the intent of Measure D. Accordingly, if this task is to be included in the proposed scope, then the funding of the Alternatives Analysis should be shared by both the rail and the Metro measure D funds.
We urge you to add the following criteria to the scope of work for the Alternatives Analysis. Any quality high capacity transit on our ROW should:

- provide the best transportation synergy for pedestrians and cyclists to address the first and last mile challenges to adoption
- be convenient enough to be a realistic alternative to cars for the most people possible
- use the least energy per capita transported
- have the lowest greenhouse gas emissions per capita transported
- maintain our active rail line so we preserve the easements that allow us to use the ROW
- be the most reliable, providing the best travel times to riders
- have the capacity and capability to scale up easily as ridership grows
- provide the best integration with statewide transit system, current and planned.
- be implemented as quickly as possible
- be easily accessible for the handicapped
- coordinate well with other services like bus and paratransit
- be the most economically efficient, with lowest operating cost per passenger mile

At a minimum, inclusion of these essential environmental and social equity factors is needed to make a sound decision.

Respectfully yours,

Sally Arnold

*Board Chair, Santa Cruz County Friends of the Rail and Trail*
From: Rosemary Sarka <rosemarysarka@gmail.com>
Sent: Wednesday, June 26, 2019 8:41 AM
To: Regional Transportation Commission <info@sccrtc.org>
Subject: Alternatives Analysis

Please slow down in your study of alternatives for use of the rail corridor. Allow for public comment and further analysis. Full use of the corridor may be many years away and the latest technology must be taken into account in forming a decision. Furthermore, local sensitivities about this issue are intense and the result of study needs time to be assimilated.
Rosemary Sarka

From: Dan Dion <dandion1@me.com>
Sent: Wednesday, June 26, 2019 9:01 AM
To: Regional Transportation Commission <info@sccrtc.org>
Subject: Comments on the Alternatives Analysis

Greetings RTC,
We have a few comments on the Alternatives Analysis related to the performance measures. We are disappointed that we were not offered an opportunity to comment on the performance measures to reflect our needs and desires. If the RTC had opened the performance measures to public input, we believe the results of the analysis would more closely reflect the needs and desires of our diverse communities. Please take more time to solicit public input and correct this oversight.

The Unified Corridor Investment Study (UCS) identified priority transportation investments on Highway 1, Soquel Ave/Dr and Freedom Blvd and the Santa Cruz Branch Rail Line (SCBRL) that will maximize mobility and environmental benefits. We don’t understand why the performance measures include so few measures related directly to environmental and mobility. We count 1 or 2 measures each when 5 or 6 would provide a more balanced analysis. A more balanced approach should include more environmental and mobility measures. Additional measures should include which mode carries more bicycles, which mode generates the least amount of waste at the end of useful life, which mode provides optimal transit alternatives for our mobility and economically challenged residents regardless of community, which mode provides best on-time arrivals and departures.

We thank you for your efforts,
Jill and Dan Dion
Santa Cruz

From: kaki rusmore <krusmore@gmail.com>
Sent: Wednesday, June 26, 2019 7:45 AM
To: Regional Transportation Commission <info@sccrtc.org>
Subject: Alternatives analysis

Dear RTC members,
In your analysis of potential alternatives for transportation on the rail corridor, I'm concerned that the present process does not adequately address environmental and equity concerns. It's important to have a system that can scale up easily as ridership increases and includes a wide array of environmental concerns, beyond those presently included.

Thank you,
Kaki Rusmore
Aptos
From: David Brick <dbrick@cruzio.com>
Sent: Wednesday, June 26, 2019 7:10 AM
To: Regional Transportation Commission <info@sccrtc.org>
Subject: RTC 6/27/19 item 18 Alternatives Analysis

Dear RTC Board Members,

At its Thursday meeting, the RTC will consider beginning an Alternative Analysis (AA) -- the end result of which will be to decide what the “Locally Preferred Alternative” will be for high capacity public transit on the rail corridor.

The proposed AA scope of work was prepared without public input, and is lacking in several important respects. While it appears the proposal does good job on the issues of ridership and money, the proposed scope barely mentions environmental and social equity issues.

These are important issues to our community. To ensure that the best possible alternative is selected by the RTC, the scope of the AA should be revised and in doing so, provide for public input before adoption.

Very truly yours,

David Brick
101 Alta Vista Drive
Santa Cruz CA 95060

From: Dennis Norton <DNortonDesigns@msn.com>
Sent: Wednesday, June 26, 2019 12:20 AM
To: Molly Ording <mollyording@yahoo.com>; Regional Transportation Commission <info@sccrtc.org>
Subject: Re: RTC 6/27/2019, Item 18 Alternatives Analysis

Well written Molly
Dennis from Portugal riding trains, trolleys and buses
Love ya.

Get Outlook for iOS

From: Molly Ording <mollyording@yahoo.com>
Sent: Wednesday, June 26, 2019 4:12:21 AM
To: info@sccrtc.org
Subject: RTC 6/27/2019, Item 18 Alternatives Analysis

Dear Members of the Regional Transportation Commission:

We have watched the rail corridor with both great interest and great enthusiasm from its purchase years ago to your current consideration of public transit alternatives on the rail corridor tomorrow.
Our interest and enthusiasm for the options of **both** rail and/or some mode of high capacity public transit, as well as a walking biking trail, stems from our own personal commitments and dedication. Concern for our fragile environment and this amazing opportunity of reducing green house gases as well as the immeasurable social equity benefits which will stem from workers having affordable and convenient methods of commuting to their jobs...as well as, of course, increased mobility & transportation options for residents and visitors alike. A "win-win" for ALL!

As an example, in the past months we have, unfortunately, spent an inordinate amount of time at many local physicians' offices. I have made it a point of enquiring their office staffs about their commuting habits. It was affirming to hear that for, by far and away the majority of them, if there was an affordable and convenient method of public high capacity transportation to use on the rail corridor, they would DEFINITELY use it...to save time, money and the environment! All of our goals...but this one is within all of our/their reach!

Let’s take all the steps necessary to ensure that moving forward, our rationale for creating viable public transit modes will include the **three imperative and integral pieces of progress**: financial viability, greenhouse gas reductions and environmental solutions and social equity opportunities.

We appreciate all your consideration both in the past present and future. We, as united and unique coastal communities, have this amazing opportunity to accomplish all 3 goals through a “locally preferred alternative” that takes into account ALL of the above!

With sincere thanks for your past and future considerations and wisdom...

Molly & Mickey Ording  
218 Monterey Avenue  
Capitola, Ca. 95010  

831/334-5559

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**From:** robert arko <robarko@gmail.com>  
**Sent:** Tuesday, June 25, 2019 11:36 AM  
**To:** Regional Transportation Commission <info@sccrtc.org>  
**Subject:** The proposed scope of work for the SCRTC Alternatives Analysis

Dear RTC Commissioners,

I have reviewed your proposed scope of work defining the process of planning to compare different kinds of “high capacity public transit” on the Rail Trail corridor and have several concerns.

- The scope does not adequately address environmental criteria. The only issue included is an evaluation of vehicle miles traveled and associated greenhouse gas emissions. We need a solution that best augments with the trail and addresses first and last mile considerations. Numerous studies prove a rail solution tied to a cycling trail amplify the usage of both of these modes of transportation. This more systemic approach is key to providing our residents with a safe and convenient alternative to automobile use.
- The scope does not adequately address social equity criteria to achieve the most economically efficient solution, with lowest operating cost per passenger mile to benefit all residents of the county.
- This analysis should be funded **equally** with Metro and Rail Trail Measure D funding, not exclusively with the Rail Trail 8% allocation.
The scope of the Alternatives Analysis includes a section to assess Metro funding through 2045. Spending rail corridor funds to support METRO is clearly inconsistent with the intent of Measure D. Metro should be spending their own share of Measure D funds for their needs.

Because of these 4 concerns I am urging the RTC Commissioners to improve the scoping document before it is approved. Thank you for your consideration of these critical inputs to your process.

Robert Arko
2 Thayer
Bonny Doon, CA 95060

From: Casey Beyer <casey.beyer@santacruzchamber.org>
Date: June 25, 2019 at 9:37:41 PM PDT
To: Guy Preston <gpreston@sccrtc.org>
Subject: Alternative Analysis for Public Right of Way on the Corridor

Guy — As you know the Chamber has been the leading business advocate to get people moving in Santa Cruz County for years, well before the passage of Measure D and SB 1 — we have always advocated for best practices and most efficient means to utilize the limited transit corridors in Santa Cruz County - understanding the two controversial corridors are Highway 1 and the Rail Corridor — which has divided constituencies.

The Chamber will review the RTC agenda and this item in greater detail to prepare for formal input for Thursday’s meeting.

As the RTC commission explores this item it is significant that most of the discussion to date on this item has been between the RTC staff and the Metro staff. There has been no input from the public until this Item was placed on the RTC’s agenda for Thursday’s meeting. The RTC scope of work needs to address equity, environmental and economic feasibility on the Corridor.

1. The Regional Transportation Commission (RTC) intends to engage the services of a consultant to produce an Alternatives Analysis and Business Plan for High Capacity Public Transit on the Rail Right-of-Way. RTC and METRO staff have been working together on the scope of work to be released in the request for proposals. **RTC staff recommend that the RTC review and provide input on the scope of work (Attachment 1) to be released for the Alternatives Analysis.**
Dear RTC Commissioners,

I've been following the rail with trail issue closely for a few years and am excited it is moving forward.

In looking at the proposed scope of work for the Alt. Analysis it appears there are 2 key aspects missing which should be included. These factors involve the environmental and community/social components of this policy. In making this pivotal decision I believe it's important to include consideration for these two overlooked factors which are key to making the very best decision possible at this junction.

In order to select the locally preferred alternative I believe RTC staff should focus on the following additional items:

1. Community input to highlight the most important environmental and social equity issues as viewed by the community then
2. Modify the scope to include these additional identified environmental and social equity factors

The decisions you are making require great care, have long term effects and are too important to neglect these items. I believe moving further through the process without consideration and inclusion of these two important factors would be a regrettable oversight we cannot afford.

Please hold off on any decisions until you've directed RTC staff to look at these issues and include them in the final decision.

I appreciate all the time and effort spent RTC and staff spends on such an important project which will have very long lasting effects.

The RTC and staff is doing amazing work.

Thank you,

Mary Miller
Santa Cruz, CA
Dear Commissioners,

I am sending the following text to register my concern regarding the Alternatives Analysis that is on your agenda for Thursday. Please do not discount my concerns based on the fact that I am copying the words of others who are also likely to write to you.

The proposed scope of work for the Alternatives Analysis (AA) is lacking in several important respects and should be revised before it is improved. While it appears the proposal does a bang up job on the issues of ridership and money, the scope does not adequately address the environmental and social equity issues so important to our community. This is particularly alarming because the 2040 Regional Transportation Plan adopted just last year, focuses on sustainability with equal consideration of people, planet and prosperity.

Inadequate consideration of 2 of the 3 foundational policy elements (people and planet) as the RTC considers making the single most important decision about the future of our transportation system is not a good sign. In fact, making such a decision while inadequately considering the environment and social equity will likely to lead to a bad decision.

Accordingly, I urge you to table this item for now and send the AA back to your excellent staff with direction to:
1. Solicit input from the community to identify the environmental and social equity factors most important to residents
2. modify the scope to include the additional environmental and social equity factors so identified

Selection of the locally preferred alternative is too important to proceed any further with the proposed AA. The future of our transportation system is at stake.

Thanks,
Claudia Brown
600 Pelton Ave
Santa Cruz
Ms. Dykar,

I understand you are working with Barrow Emerson on the scope of the upcoming Alternatives Analysis (AA) to determine what type of high capacity public transit mode should be used in the existing rail corridor. In order to provide our community with the best choice, the AA should include the following criteria. Which mode will:

- Preserve and protect the CONTINUITY of the existing rail corridor, particularly those portions of the rail corridor that exist only as railroad easements. Furthermore, which mode will accomplish preservation of the ROW at the least possible cost, at the least possible risk of any loss, at the least possible risk of time consuming and/or expensive litigation and with the greatest certainty of preserving the continuity of the entire corridor.

- Most easily meet all federal Surface Transportation Board requirements that may be needed for STB’s approval to implement the selected mode. (especially important given Roaring Camp and Big Trees Railroad’s status as a common carrier on the Santa Cruz Branch Line.)

- Have the smallest possible environmental impact on the existing rail corridor itself and minimize impact on existing flora and fauna, existing wetlands and other environmentally sensitive areas.

- Offer the greatest potential reduction of GHG emissions causing global warming or measured another way, consume the least amount of energy per passenger mile.

- Offer the most energy efficient mode for transporting both people and freight along the corridor

- Offer the best vehicle maintenance cycles and total life cycles to reduce the embedded energy cost of manufacturing replacement parts/vehicles and to reduce disposal impacts of vehicles/parts on our solid waste disposal facilities or put another way, have the lowest total cost of ownership when accounting for the replacement cost of vehicles and other equipment over a thirty year operational lifetime

- Offer the least expensive cost for maintaining the needed operational infrastructure located within the corridor ROW

- Given the ever increasing cost of labor, offer the lowest number of hours for all labor to operate and maintain the selected system per passenger carried

- Maximize the reduction of our County’s overall total VMT

- Maximize the total County-wide public transit mode share

- Have the greatest positive impact on social equity, offering the greatest travel freedom and opportunity to pursue education and employment opportunities to the most number of people, especially those 80,000 or so residents in south county (live below La Selva Beach)

- Minimize impacts on local surface streets and neighborhoods
Be able to be fully implemented and operational in the least amount of time

Allow the planned MBSTT Rail Trail to be constructed in the least amount of time and at the least possible cost with minimal threats to existing funding and with no adverse impacts on any design, permitting and construction activities currently underway or planned to occur within the next three years.

Given our County's ever increasing use of cycling as a transportation mode and the inherent ability of bicycles to solve the first/last mile problem, the selected mode should have a demonstrated capacity to carry the maximum number of bicycles and with the least effort required by the cyclist.

Maximize the opportunities for outside state and federal funding of major infrastructure needs such as replacement of the existing rail bridge/trestle over Soquel Creek in Capitola and other existing infrastructure within the rail corridor that will need upgrading and/or replacement in the next 20 years.

Offer the fastest, most reliable transit times during both am and pm peak traffic travel periods under both current traffic patterns and anticipated future traffic conditions due to the likely continued increase in our County's population and likely increased congestion in both N to S and S to N primary commuter travel directions.

Offer the best possible solution to the ‘Aptos Strangler’ conditions described by Jarrett Walker during his 2018 presentations to the RTC and the community. I.e. utilize the existing rail corridor all the way through the Aptos area currently constrained by the four lane Highway 1 and the two lane Soquel Ave.

Best uses the entire length of the corridor

Best integrates with the 2018 State Rail Plan and the State’s vision for integrated high capacity public transit service throughout California and especially the SRP vision for the Monterey Bay Area.

Lastly, be the most attractive mode for visitors to our County from elsewhere allowing the maximum amount of car-free travel to, from and within our County. This criteria may become increasingly important as tourism is such a big part of the local economy.

I trust you will include the above criteria in the scope of work for the AA so both current and future residents of and visitors to Santa Cruz County get the best possible mix of transportation uses in our rail corridor.

As always, should you have any questions or comments regarding any of the above, please contact me.

Thank you,

Mark Mesiti-Miller
Professional Civil Engineer
36 year resident of Santa Cruz
(831) 818-3660
Hello Guy, Ginger:

This may be way too specific and premature a reference, but I know that PTC has been a big, problematic, expensive deal and could come up on our line.

Cheers,

Bruce

https://www.progressiverailroading.com/ptc/article.aspx?id=57271&source=pr_digital3/22/17&email=bksawhill@cnsp.com

Here are some important pieces of data. One is a survey of commute patterns (a big spreadsheet) that shows (if you dig) that there are about *five times* as many people commuting within the County as coming in or going out (especially over the hill) to other counties. I also extracted the key data in <CommuteFlows>, but I included the original USDOT report <CommuteFlowsMaster> for veracity. Some people say transit solutions in the County are hopeless because “everyone” goes over the hill, but the data show otherwise. I am also including density maps from a cool program I found called SocialExplorer that show that the mid_county area and part of Watsonville are remarkably dense, more typical of places like Oakland or Portland than suburbs like Livermore or Petaluma. One map has been marked up by Peter Scott to show where the rail line is, the other filters only for Census tracts that have a density over 8,000 people per sq. mi., with a very striking result.

Best,

Bruce
<table>
<thead>
<tr>
<th>County</th>
<th>Out To County</th>
<th>In To County</th>
</tr>
</thead>
<tbody>
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<td>4045</td>
</tr>
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</tr>
</tbody>
</table>

Hi Ginger-

I did a cost-benefit analysis for the UCIS last fall, and even though all of the numbers will be rendered obsolete by the Alternatives Analysis, the methodology remains useful. Here’s the document:
Cost/Benefit Analysis of the UCIS Study Alternatives
Bruce Sawhill, PhD • October 21, 2018

The recently released Draft UCIS contains four scenarios for future transportation options on the three main north/south corridors in our County. Since the “I” in UCIS stands for “Investment”, why not attempt to subject the scenarios to the kind of investment analysis that is usually undertaken for more conventional investments, like buying stocks, buildings, farm property, etc.?

Transportation investments are not as simple as most other investments and transportation infrastructure affects many intangibles as well as tangibles. That said, the UCIS has given us several measures of effectiveness that can be translated into dollars. The two largest effects are VMT (“vehicle miles traveled”) and accidents prevented.

For a conventional investment, one looks at the capital cost and the carrying cost—How much something costs to buy and how much it costs to keep it up. A good investment makes enough money to not only exceed the carrying cost but to pay back the capital in a reasonable amount of time. As it turns out, the benefits of all of the scenarios except A exceed the carrying costs, but only two of them “pay back” the capital in a reasonable amount of time.

For the UCIS, we have carrying cost (“operations”) and capital costs, divided into local and non-local components. We also have benefits in terms of VMT’s (increase or decrease) and accident reductions, compared to the “No Build” (do nothing, spend nothing) alternative. The costs and benefits are calculated in terms of local quantities.

The following spreadsheet shows the operations and capital costs of each of the four scenarios and the monetized effect of VMT changes as well as accident reductions. The VMTs are priced at the Federal reimbursement rate of 54.5 cents per mile (2018) and the accidents are priced at 88.2% of the $223,700 cost of each accident as quoted in the UCIS. 88.2% is used because that is the indirect cost of each accident; because the reduction in direct costs largely benefits insurance companies.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Cap</th>
<th>Ops/yr</th>
<th>Colls</th>
<th>VMT/day</th>
<th>Yearly Net</th>
<th>Net: 20 yrs</th>
<th>Net: 30 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Build</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>-400</td>
<td>-550</td>
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<tr>
<td>A</td>
<td>520</td>
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<td>-248</td>
<td>150,000</td>
<td>-1</td>
<td>-400</td>
<td>-550</td>
</tr>
<tr>
<td>B</td>
<td>379</td>
<td>16</td>
<td>-366</td>
<td>-80,000</td>
<td>-1</td>
<td>-736</td>
<td>1,294</td>
</tr>
<tr>
<td>C</td>
<td>205</td>
<td>11</td>
<td>-252</td>
<td>-60,000</td>
<td>309</td>
<td>503</td>
<td>896</td>
</tr>
<tr>
<td>E</td>
<td>794</td>
<td>6</td>
<td>-257</td>
<td>120,000</td>
<td>9</td>
<td>-607</td>
<td>-914</td>
</tr>
</tbody>
</table>

Scenarios B and C are clear winners here, with B producing almost $400 million additional benefit over 30 years than C.

Build the Trail. Keep the Rail. RailAndTrail.org 🗞️➡️
The same information can be viewed in graphical form, to show the return on investment of the different scenarios over time. The vertical scale is in millions of dollars.

All of the scenarios start in negative numbers (representing the initial investment) and then change over time by the net gain or loss on operations, VMTs, and accidents. Both Scenarios B and C have a break-even time of about 7 years and generate net positive value after that. Scenario A never breaks even. Scenario E breaks even after 65 years, not shown on the above graphic. After 30 years Scenario B has delivered over $1.2B in value and the spread between the best and worst scenarios (B and E) is a whopping $1.8 billion.

In conclusion: A return on investment analysis of corridor scenarios is important for an investment of this size and complexity. Though all of the scenarios are preliminary, it is clear at this point that B is the winner by a significant margin, I feel this is a compelling reason to choose it. — Bruce Sawhill, PhD

References: [https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813193](https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813193)

APPENDIX

Testing assumptions: These calculations, like all financial analyses, depend on assumptions. What happens if we change key assumptions like the cost of operating a car or how much financial assistance we get from outside the County?

A) Marginal cost of driving instead of total cost – No lifestyle changes, no cars bought or sold in response to transit or lack thereof – people just use exactly the same number of cars to drive more or less, retaining the costs of car ownership. Replace 54.5 cents/mile with 32 cents/mile. Result: Scenarios B and C pay back in 8 years, A and E in 40-50 years. B ahead of C by $350M in 30 years with a net value of $1.1B. Best to worst spread@30yrs (B vs A): $1.3B

B) Worst case funding scenario: No help from outside, all expenses paid locally. Result: B first to pay back (33 years). Value of B $38M better than C (next closest) at 30 years. Best to worst spread@30yrs (B vs E): $1.9B

C) Perfect storm: Use marginal cost of driving plus no outside financial help. Result: B first to pay back (46 years), C ahead of B at 30 years by $9M. Best/worst spread@30yrs (C&B vs E): $1.48
Hi Ginger-

I hope I’m not bombarding you with too much information, but here is a 2015 proposal for streetcar service in Portland that has a good survey of state-of-the-art in streetcar/light rail type applications, including a list of what qualifies as “buy American” (much longer than I thought) and what manufacturers have all or partial off-wire solutions.

Cheers,
Bruce


Hydrogen fuel cell train in current usage:

https://en.wikipedia.org/wiki/Alstom_Coradia_LINT

Bruce Sawhill  
Santa Cruz, CA

Here is the first installment of documents—these are studies from Michael Setty, one for regular passenger transit, one for excursion (tourist) operations, and an Appendix that includes direct service to Cabrillo College and a better link to downtown. He used the same methods as used by Fehr and Peers in 2015.

Cheers,
Bruce

DOCUMENTS AVAILABLE at https://sccrtc.org/projects/multi-modal/unified-corridor-study/
Dear Members of the Regional Transportation Commission:

We have watched the rail corridor with both great interest and great enthusiasm from its purchase years ago to your current consideration of public transit alternatives on the rail corridor tomorrow.

Our interest and enthusiasm for the options of both rail and/or some mode of high capacity public transit, as well as a walking biking trail, stems from our own personal commitments and dedication. Concern for our fragile environment and this amazing opportunity of reducing green house gases as well as the immeasurable social equity benefits which will stem from workers having affordable and convenient methods of commuting to their jobs...as well as, of course, increased mobility & transportation options for residents and visitors alike. A "win-win" for ALL!

As an example, in the past months we have, unfortunately, spent an inordinate amount of time at many local physicians’ offices. I have made it a point of enquiring their office staffs about their commuting habits. It was affirming to hear that for, by far and away the majority of them, if there was an affordable and convenient method of public high capacity transportation to use on the rail corridor, they would DEFINITELY use it...to save time, money and the environment! All of our goals...but this one is within all of our/their reach!

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We appreciate all your consideration both in the past present and future. We, as united and unique coastal communities, have this amazing opportunity to accomplish all 3 goals through a “locally preferred alternative” that takes into account ALL of the above!

With sincere thanks for your past and future considerations and wisdom...

Molly & Mickey Ording
218 Monterey Avenue
Capitola, Ca. 95010

831/334-5559

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Dear Commissioners,

I am disappointed in the proposed AA as well as the lack of community involvement in crafting it. I think more needs to be done to address the important environmental criteria. Social equity issues should be taken into consideration as well. I hope the document can be revised and improved so that the best possible alternative is achieved.

Thanks for all you are doing to move the Rail Trail forward!

Trician Comings
Dear RTC Board Members,

Please **improve** the scope of alternatives for high capacity public transit on the rail corridor **before voting on this issue** at your meeting on Thursday, June 27th. Here are some reasons improvement is needed.

Besides considering greenhouse gas emissions, please think about how high capacity public transit on the rail corridor will augment a safe bike and pedestrian trail, especially for the first and last mile. For example, can Jump Bike Stations be added near the entire length of the rail corridor to help facilitate the first and last mile of travel? Can Metro routes be synchronized so they meld easily with transit stops along the rail corridor?

When considering a safe bike and pedestrian trial, please consider social equity before voting. Are you planning to preserve easements along the corridor so as to insure the right of way and not get bogged down in expensive litigation from wealthy residents that may impede corridor construction? Please make sure that all legal requirements regarding easements are in place, so that the rail trail may be constructed as soon as possible! (You will save lives if you implement this trail sooner rather than later, as the only safe path for bicyclists, pedestrians and the handicapped is an off-road path!) Please remember to consider preserving easements before voting!

I ask that you not forget about citizens in the paratransit category. Please consider bus transport to and from the rail corridor, as well as the coordination of paratransit services and schedules with rail transit.

Equity applies to the Measure D funding spent on the Alternatives Analysis as well. While Metro is important for its future connection to the transportation network, the analysis which you will vote on this week is being funded 100% by the rail corridor study section of Measure D. Metro is not funding this analysis.

Because of these reasons, please **improve** your Alternative Analysis before **approving** it! Thank you!

—Grace Voss
Dear Commissioners,

The proposed scope of work for the Alternatives Analysis (AA) is lacking in several important respects and should be revised before it is approved. While the proposal appears to address the issues of ridership and money, the scope does not adequately address the environmental and social equity issues so important to our community. This is particularly alarming because the 2040 Regional Transportation Plan adopted just last year, focuses on sustainability with equal consideration of people, planet and prosperity.

Inadequate consideration of 2 of the 3 foundational policy elements (people and planet) as the RTC considers making the single most important decision about the future of our transportation system is not a good sign. In fact, making such a decision while inadequately considering the environment and social equity will likely to lead to a bad decision. I urge you to table this item for now and send the AA back to your staff with direction to:

1. Solicit input from the community to identify the environmental and social equity factors most important to residents.

2. Modify the scope to include the additional environmental and social equity factors identified.

Selection of the locally preferred alternative is too important to proceed any further with the proposed AA. The future of our transportation system is at stake.

Thank you,

Paula Bradley
P O Box 1146 Capitola CA 95010
Dear SCCRTC,

Regarding mass public transit, the best choice is light rail service. Don’t put off building the bicycle and pedestrian trail next to the rail corridor. After completion of the trail, please immediately build a light rail servicing the entire Santa Cruz County.

Sincerely,
Sam Robins
Aptos, CA 95003

Dear Commissioners,

The proposed scope of work for the Alternatives Analysis (AA) is lacking in several important respects and should be revised before it is improved. The scope does not adequately address the environmental and social equity issues so important to our community. This is particularly alarming because the 2040 Regional Transportation Plan adopted just last year focuses on sustainability with equal consideration of people, planet and prosperity.

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Accordingly, I urge you to table this item for now and send the AA back to your excellent staff with direction to:

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Selection of the locally preferred alternative is too important to proceed any further with the proposed AA. The future of our transportation system is at stake.

Thanks,

David Baskin, Santa Cruz City Resident
Thank you Commissioners and Staff for your public service and commitment to transportation improvements. Thank you always for considering and including the disadvantaged economic environment of our South County Watsonville residents.

The Progressive operators hauled freight in Watsonville yesterday and that felt like jobs, revenue, and trucks taken off of congested roads for our community.

When it comes to analysis, a more efficient level of service developed through a Locally Preferred Alternative is a good idea, but there are several factors to consider. Primarily the public input on broad environmental factors, and the depth of social equity results effecting disadvantaged communities. Any preferred plan should have a wide scope and a deep dig with public input on these issues.

Good luck and let’s get moving.

Lowell Hurst
Council Member District 3
Former Mayor
275 Main St Suite 400
Watsonville CA. 95076
Office 831-768-3008
Voice mail 831-768-3003

"Over 30 years serving the community"
“Celebrating 150 years of history in Watsonville”
https://www.watsonville150.org/

Dear RTC commissioners and staff.

You might remember that the Measure D share to the Rail Corridor was 15% in early 2016 but was whittled down to just 8% by November, barely enough to maintain the line, much less create transit.

Most of the shift in share went to support Metro and para transit, and that was much needed but we lost funding for a passenger rail station at Pajaro junction and we saw severe storms create several washouts.

And now our system is broken at mile post 5 where washouts occurred due to lack of maintenance.

Last fall we saw the conclusion of the Unified Corridors Investment Study and its recommendation of Scenario B, including rail transit and trail for the rail corridor. Unfortunately, the "Preferred Scenario" was modified away from rail transit as the solution, and the Metro board requested further analysis of bus or other transit on the rail corridor. Note that none of the bus transit routes utilize the full corridor, all of them go to the highway at State Park Drive.

Also note that rail corridor funds were used to pay for the UCIS study and are now targeted AWAY from rail infrastructure maintenance to further study of options other than rail.

We own a working permitted rail line and should be maintaining it and utilizing it as the first priority.
I encourage commissioners to challenge the alternatives analysis and insist that rail corridor funds be used, as promised to voters, to maintain the rail infrastructure as a top priority.

Thank you,

Barry Scott
Aptos, CA

June 26, 2019

Dear Regional Transportation Commission,

At the RTC meeting this coming Thursday, you will be considering a proposal to move forward with an Alternative Analysis (AA) to determine whether the rail corridor will be used for trains or buses (passenger rail transit or bus rapid transit).

The proposed scope of work for the AA directs the consultant to examine 14 different performance criteria of which only 1 is related to the environment and only 1 is related to social equity. Given that the economy, the environment and equity are equally important when making decisions, it is unfair that the 12 factors are related to the business plan and only 1 factor each is related to the environment and equity. Before the RTC can make an informed decision about whether the rail corridor will be used for trains or buses, there are many more environmental issues that should be evaluated such as:

- which mode will use the least amount of energy per passenger
- which mode will minimize the amount of waste going to landfills (trains last about 3x longer than buses)
- which mode will encourage active transportation like cycling (trains typically carry 30 bicycles, buses only 3)
- **which mode is more fun, enjoyable and likely to get people out of cars.**

There are also many more equity issues that should be evaluated, such as:
- which mode will encourage disadvantaged residents and visitors to use public transit allowing people to get rid of the high cost of owning a car
- which mode will provide the fastest and most reliable on-time performance
- which mode provides the best connection between affordable housing centers and job/education centers

Lastly, and perhaps most importantly, the proposed scope of work was prepared behind closed doors and the public was never invited to share those things most important to them. If the RTC is going to spend $650,000 of the taxpayers money, the RTC should invite the public to share what is important to them especially regarding the environment and equity.

I want the RTC to slow down, invite public participation, add more environmental and equity factors and develop a better AA so we can make a fully informed decision about whether buses or trains should run in the rail corridor.

Thank you,
Sincerely,

William LeBon

Founder of:
- The Santa Cruz Hub for Sustainable Transportation
- Pedaler’s Express
- Santa Cruz Friends of the Rail Trail
- The Green Station
- Peregrine Fuels
Chair Bottorff and Commissioners,

Given the importance of our transportation system and our rapidly warming planet, it was good to see a proposed Alternatives Analysis (AA) on the agenda and it will be good to move forward on this important work when the AA has been sufficiently improved to lead our community in making the best decision possible. At the moment, the proposed AA is lacking in several important ways and must be substantially improved before it is approved. Everyone knows that now, before you solicit proposals, is the best time to get the scope right as making changes later will only add cost and delay completion.

While 12 of the 14 performance measures included in Task 3 of the proposed AA adequately address economic vitality issues like money and ridership, the scope barely addresses the natural environment (1 measure) and healthy communities (1 measure) issues so important to our community. These deficiencies are particularly alarming as the theme of the 2040 Regional Transportation Plan (RTP) is sustainability defined by using a Triple Bottom Line (TBL) analysis in which people, planet and prosperity are given equal weight. In fact, Chapter 1- Why Sustainability opens with the graphic to the right.

Furthermore Chapter 4 of the RTP opens with the following paragraph

The Santa Cruz County Regional Transportation Plan (2040 RTP), through its goals and policies, sets forth a foundation for expanding options for residents and visitors to access their daily needs in a way that is safe, equitable, protects the environment and promotes investment in the local economy. This is advanced by designing and implementing a transportation system that serves our diverse travel needs and embraces the principle that transportation is intertwined with environmental, economic and social concerns.

Barely mentioning two of the three foundational policy elements (people/social equity and planet/environment) as you make a decision about our transportation system, a decision that will impact our community for the next 30 to 50 years or longer, is frankly unacceptable.

Essentially ignoring the people and the planet will not lead to the best decision. In fact, it will most likely lead to a bad decision, a bad decision we literally can't afford to make.
The proposed scope only includes a single environmental measure, namely "vehicle miles traveled and associated greenhouse gas emissions" yet there are many more environmental issues that could and should be evaluated such as:

- Which alternative will maximize active transportation users (a train can carry ten times the number of bicycles as a bus)
- Which alternative will use the least amount of energy per passenger mile (over 50 years of operation, this can really add up)
- Which alternative will minimize solid waste going to our landfill (trains last about 3x longer than buses and don't use rubber tires)

Similarly, the proposed scope includes only a single measure of social equity, namely "service to disadvantaged communities", whatever than means, yet there are many more equity issues that could and should be evaluated such as:

- Which alternative will maximize active transportation users (bicycles can be rolled onto a train but must be lifted onto a bus rack limiting use by weaker individuals)
- Which alternative will most encourage disadvantaged residents and visitors to actually use public transit thereby allowing people to get rid of the high cost of owning a car
- Which alternative will provide the most reliable on-time performance allowing folks to get to their jobs on-time and keep them

The truth is there are many more environmental and equity issues than listed above that could and should be evaluated but because there was no outreach into the community to discover what is important to the users, the scope of the proposed AA is incomplete. Please direct staff to reach out to the community for their input on these issues before proceeding any further.

Lastly, the staff report correctly references a specific outcome of the UCS directing staff to: Protect the rail right-of-way for a high-capacity public transit service next to a bicycle and pedestrian trail and continue to consider passenger rail service on the rail right of way consistent with Prop 116 requirements; and

Yet there is not a single item in the AA scope that addresses protection of the ROW. At a minimum, the AA should include an evaluation of which alternative will best protect the continuity of the existing rail corridor, particularly those portions of the rail corridor that exist only as railroad easements. Furthermore, an evaluation of which alternative will accomplish protection of the ROW at the least possible cost, at the least possible risk of any loss, at the least possible risk of time consuming and/or expensive litigation and with the greatest certainty should be included.

Everyone wants the best possible AA to inform this most important decision. Please take a month or two now to amend the AA. The resulting decision will affect the quality of our transportation system and more importantly the quality of life in our community for decades.

Thank you,
Mark Mesiti-Miller, P.E. Professional Civil Engineer County and City of Santa Cruz resident for the past 36 years