Energy: The Key to Entitlements for Podcar Networks
Ron Swenson
November 6, 2015

International Institute of Sustainable Transportation
www.inist.org
We are organizing a network of universities to create **sane** transit networks around the world.
We are organizing a network of universities to create **sane** transit networks around the world

- Solar-powered ...
We are organizing a network of universities to create **sane** transit networks around the world

- *Solar-powered* ...
- *Automated* ...
We are organizing a network of universities to create **sane** transit networks around the world

- *Solar-powered* ...
- *Automated* ...
- *Nonstop* ...
We are organizing a network of universities to create **sane** transit networks around the world

- Solar-powered ...
- Automated …
- Nonstop …
- Elevated …
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- **Solar-powered** ...
- **Automated** ...
- **Nonstop** ...
- **Elevated** ...

*for transportation beyond oil*
SANE Transportation Networks are unique & robust
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- Small, driverless vehicles
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- Exclusive, grade-separated guideway
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Off-line stations: non-stop from origin to destination
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- Safe
- Solar powered
Let's consider our origins
FIRE defined humanity ...

“Evidence for the controlled use of fire by Homo erectus beginning some 400,000 years ago has wide scholarly support, with claims regarding earlier evidence finding increasing scientific support.”
But now FIRE is raging out of control
But now FIRE is raging out of control

Arctic Expert predicts final collapse of sea ice within four years

guardian.co.uk
Monday 17 September 2012
But now FIRE is raging out of control
But now FIRE is raging out of control
Australia has a new temperature rating:
Australia has a new temperature rating:
Australia has a new temperature rating: catastrophic
If climate change doesn’t get us...
If climate change doesn’t get us...
Peak oil will...
… Peak oil will

The oil glut is a Wall Street fiction
Knowing this, where would you build podcars?
The export land model reveals a very different turn of events
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**Egypt: Oil**

2013 imports increased by 39. %

Data: BP Statistical Review 2014   Graphic: mazamascience.com
The export land model reveals a very different turn of events.

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Rising consumption

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The export land model reveals a very different turn of events.

**Egypt: Oil**

2013 imports increased by 39.%

- **Rising consumption**
- **Disappearing exports**

Data: BP Statistical Review 2014   Graphic: mazamascience.com
Oil dominates transportation energy in the USA.
But after oil is extracted, process losses are huge.

Figure 3: Boundaries of various types of EROI analyses (standard EROI (EROI\textsubscript{st}), EROI at the point of use (EROI\textsubscript{pou}) and extended EROI (EROI\textsubscript{ext})) and energy loss associated with the processing of oil as it is transformed from “oil at the well-head” to consumer ready fuels (figure adapted from Lambert and Lambert, in preparation [3]).
At the end of the daisy chain, liquid fuels don’t cut it

**Fuel-based engines are incredibly inefficient**

100kg people & 1,000 kg metal: most of the useful energy is used to move metal…

Less than 1% of the total energy moves people!
Even if there were plenty of oil, gas and coal, we would have to leave most of it in the ground.

**Unburnable fossil fuels**

Known, extractable coal, oil and gas reserves that must not be burnt in order to prevent dangerous climate change of more than 2°C.

**Global reserves**
Per cent that cannot be burned

- **Coal**: 82%
- **Gas**: 49%
- **Oil**: 33%

*Guardian Graphic*  
The future is in our hands
The future is in our hands
So June 15, 1752 is a date to remember
October 22, 1879 is also a key date to remember
October 22, 1879 is also a key date to remember

"Sunshine is spread out thin and so is electricity. Perhaps they are the same, sunshine is a form of energy, and the winds and the tides are manifestations of energy."

“Do we use them? Oh, no! We burn up wood and coal, as renters burn up the front fence for fuel. We live like squatters, not as if we owned the property.

“There must surely come a time when heat and power will be stored in unlimited quantities in every community, all gathered by natural forces. Electricity ought to be as cheap as oxygen...." [1910]
The Global Solar Energy Balance is in our favor

<table>
<thead>
<tr>
<th>Solar Energy Input</th>
<th>(TeraWatts)</th>
<th>178,000</th>
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</thead>
<tbody>
<tr>
<td>Reflected to Space Immediately</td>
<td></td>
<td>53,000</td>
</tr>
<tr>
<td>Absorbed and Then Reflected as Heat</td>
<td></td>
<td>82,000</td>
</tr>
<tr>
<td>Used to Evaporate Water (Weather)</td>
<td></td>
<td>40,000</td>
</tr>
<tr>
<td>Captured by Plant Photosynthesis</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td><strong>Total Energy Used by Human Society</strong></td>
<td></td>
<td><strong>15</strong></td>
</tr>
<tr>
<td>Total Energy Used by US Society</td>
<td></td>
<td>2.5</td>
</tr>
<tr>
<td>Total Human Food Energy</td>
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We can't solve problems by using the same kind of thinking we used when we created them.

– Albert Einstein
We can't solve problems by using the same kind of thinking we used when we created them.

Pete Christensen

– Albert Einstein
Tonatiuh inspired the Solar Skyways Challenge
The ATN guideway has 17X more solar capacity than solar race cars

\[ 2 \text{ seconds apart @ 90 km/hr} = 50 \text{ m} \]
One lane of bio-cars

How wide would the biofuel plantation be?

One lane of cars

60 miles per hour
30 miles per gallon
1200 litres of biofuel per hectare per year
80 metres car-spacing
One lane of bio-cars

How wide would the biofuel plantation be?

One lane of cars

60 miles per hour
30 miles per gallon
1200 litres of biofuel per hectare per year
80 metres car-spacing

= 8 kilometres wide
One lane of podcars

60 miles per hour

Solar Powered

80 metres car-spacing
One lane of podcars

60 miles per hour

Solar Powered

80 metres car-spacing

= 5 metres wide
Typical trip patterns closely match the pattern of sunshine, with evening extension.
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Is solar possible? Let’s start with the tough case: 2/3 of the way to the north pole
With a megawatt a mile, solar can deliver 20,000 trips per day, even in Sweden
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One TeraWatt of solar is enough for transportation.
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One TeraWatt of solar is enough for transportation

1 tw x 5 hours/day = 6.25 Quad/year = net useful energy for transportation. With efficiency gain of 5X, there will be surplus energy for the grid.
With suspended vehicles, inclusion of solar is easy, as illustrated by this recent project.
What about the visual impact of the solar array?
Where necessary, the solar array can be *narrower*
Where necessary, the solar array can be *minimal*.
Where necessary, the solar array can be *minimal*
We also helped Santa Cruz envision ATN
We are making progress in Santa Cruz
History of Solar Skyways
JPods patented solar podcars in 2004

1. managing emergency conditions in accordance with said protocol to safely complete said trip.

9. The method claimed in 8 said trip further comprising:
   a) accumulating time based availability of said devices by said negotiators;
   b) scheduling and executing said trips to position vehicles in response to historical demand for trips.

10. The method claimed in 1 said first power means further comprising:
    a) providing a second power means which enables transferring said power sources from an electric power grid to said vehicles and said transportation system;
    b) providing a third power means comprising solar and wind power generators integrated into the physical structure of said transportation system augmenting first power means.

11. A method of managing a transportation system for moving people, freight, and any combination whereof using a distributed communication network, intelligently design
In 2006 a practical solar mobility solution was discovered.
We created a solar visualization in 2007
Swenson Solar built an ATN-equivalent guideway that is aesthetically pleasing
We are seeing more and more solar visualizations.
We are seeing more and more solar visualizations
We are seeing more and more solar visualizations
INIST is coordinating a three sector program.
INIST is coordinating a three sector program

Universities

Cities
INIST is coordinating a three sector program

- Universities
- Cities
- Industry
INIST is coordinating a three sector program

Universities  Cities  Industry
Universities
Cities
Industry
The basic concept was demonstrated at Intersolar in San Francisco in 2014.
In May 2015, the Spartan Superway team returned to Maker Faire with a full scale prototype
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Solar Skyways can happen with international collaboration
Universities are working together – around the country and around the world

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<tr>
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Join us and... RISE ABOVE!!
We invite you to join us.
Thank you for your attention!

www.inist.org

www.podcarcity.org

www.superway.us

www.gofundme.com

www.atna.us

Automated Transportation Network Association