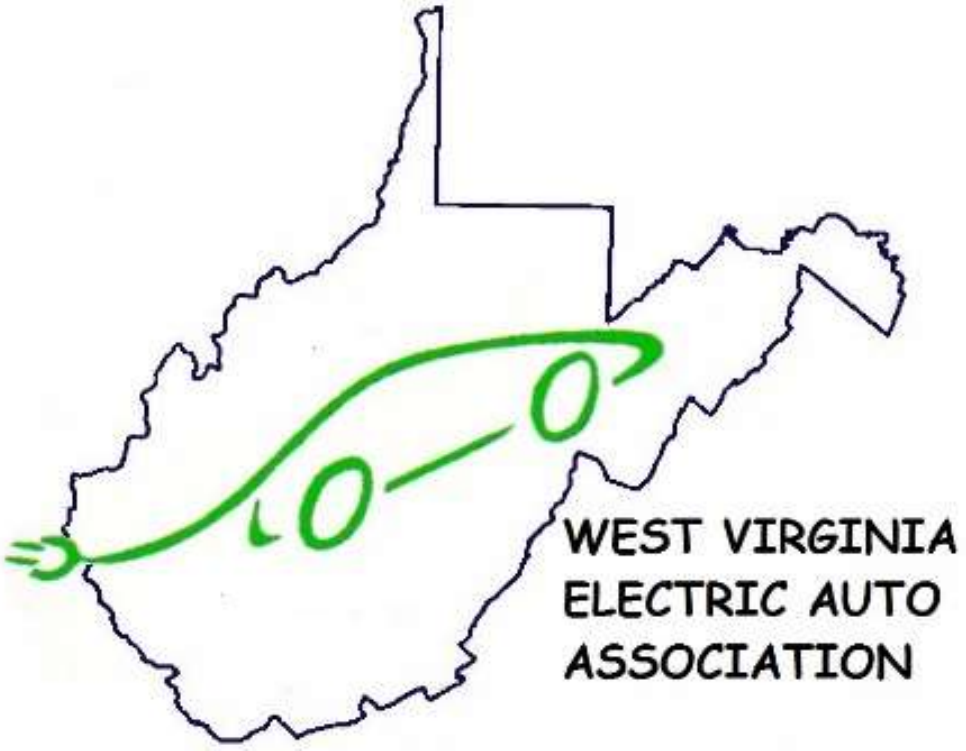
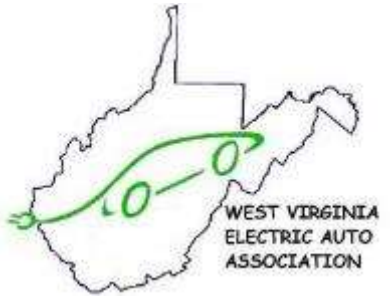
Electric Autos and West Virginia Energy



National Alternative Fuels Training Consortium

Electric Autos are not a New Concept



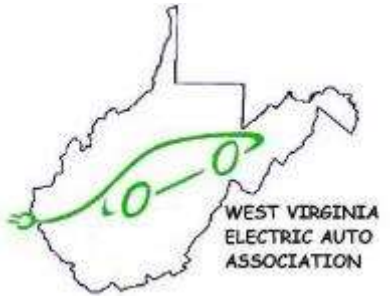
Electric Autos are not a New Concept

1909 Baker Electric

That's over <u>ONE HUNDRED</u> Years Ago

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

So, Why is Electric Making a Comeback?



So, Why is Electric Making a Comeback?

- Advances in Electrical Drive Systems and Batteries

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

So, Why is Electric Making a Comeback?

- Advances in Electrical Drive Systems and Batteries
- Electric is very Convenient – especially for Urban Commuters

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

So, Why is Electric Making a Comeback?

- Advances in Electrical Drive Systems and Batteries
- Electric is very Convenient – especially for Urban Commuters
- Very Affordable on a Day-to-Day Basis

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

So, Why is Electric Making a Comeback?

- Advances in Electrical Drive Systems and Batteries
- Electric is very Convenient – especially for Urban Commuters
- Very Affordable on a Day-to-Day Basis
- Almost No Drive-Train Maintenance

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

So, Why is Electric Making a Comeback?

- Advances in Electrical Drive Systems and Batteries
- Electric is very Convenient – especially for Urban Commuters
- Very Affordable on a Day-to-Day Basis
- Almost No Drive-Train Maintenance
- REALLY, REALLY FUN to DRIVE!

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

So, Why is Electric Making a Comeback?

- Advances in Electrical Drive Systems and Batteries
- Electric is very Convenient – especially for Urban Commuters
- Very Affordable on a Day-to-Day Basis
- Almost No Drive-Train Maintenance
- REALLY, REALLY FUN to DRIVE!

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Why should We care about electric cars?

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil – Eliminate 500 gals gas per EV/yr
  - Limited effect on the Electrical Grid

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil – Eliminate 500 gals gas per EV/yr
  - Limited effect on the Electrical Grid – Charged at night
  - Powered by COAL

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil – Eliminate 500 gals gas per EV/yr
  - Limited effect on the Electrical Grid – Charged at night
  - Powered by COAL

Electric cars use power from the electrical grid

In W.Va. they are Powered by COAL!

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil – Eliminate 500 gals gas per EV/yr
  - Limited effect on the Electrical Grid – Charged at night
  - Powered by COAL

Electric cars use power from the electrical grid

In W.Va. they are Powered by COAL!

An EV in W.Va. consumes 8 to 11 pounds of coal per day

100,000 EVs in W.Va. would consume 150K – 200K tons/year of coal

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

West Virginia Electric Auto Association
Analysis

Engineering assumptions:

Coal heating value – 13,000 BTU/lb (S. WV Steam)

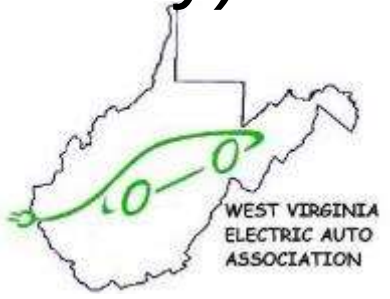
Power plant heating value – 0.67 lb coal / kwh

Electric car mileage – 3 miles / kwh

US car average miles driven – 37 miles/day

Coal Market Share – 70.2% - (from Midwest ISO)

Coal Market Share – 95% - (West Virginia only)



Say What? **100K EVs in our Region?**

- There are **455,000** plug-in cars **NOW** in USA
- 26 models across 15 brands – Today
- More than 50 new models in pipeline
  - From GM, Ford, Nissan, BMW, Audi, VW, Mitsubishi, Volvo, Apple and others

One Million EVs will consume 1.5MM – 2MM tons/year of Coal and save 500MM gals of gas

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Access Control for Public Charging

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Or

Who Pays?

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Open Access

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Open Access

- Sponsor pays

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Open Access

- Sponsor pays
- Marketing Effort – attract high income customers

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Open Access

- Sponsor pays
- Marketing Effort – attract high income customers
- Lowest cost installation

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Open Access

- Sponsor pays
- Marketing Effort – attract high income customers
- Lowest cost installation
- Difficult to control abuse

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Open Access

- Sponsor pays
- Marketing Effort – attract high income customers
- Lowest cost installation
- Difficult to control abuse
- Wide variety of vendors

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Open Access

Tesla EVSE

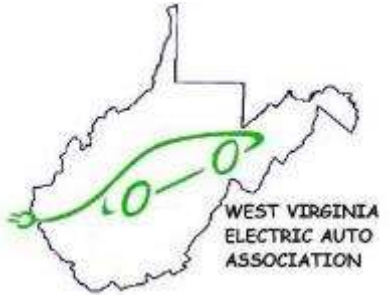
Leviton EVSE

More than 20 brands available today

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Access Control for Public Charging

Manual Access



Access Control for Public Charging

Manual Access

- Controlled by Host

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Manual Access

- Controlled by Host
- Multiple Payment Strategies

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Manual Access

- Controlled by Host
- Multiple Payment Strategies

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Manual Access

- Controlled by Host
- Multiple Payment Strategies
- Staff overhead concerns

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Manual Access

Lock and Key

$10 - $200 uninstalled
Staff operation

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Manual Access

Parking Control

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Clock and Pin

$2650 per EVSE uninstalled
$9 / month pin fee
Non-Networked

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Access Control for Public Charging

Networked

~$3700+ per EVSE uninstalled
$21 / month network fee
Requires field network

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

IN SUMMARY

EVs are Here & More are On the Way

- Advances in Electrical Drive Systems and Batteries
- Electric is very Convenient – especially for Job Commuting
- Very Affordable on a Day-to-Day Basis
- Much Reduced Vehicle Maintenance
- REALLY, REALLY FUN to DRIVE!

West Virginia stands to benefit:

- Increased Coal Usage
- Reduced Oil Imports
- Grid Friendly Electrical Consumption
- Market Boosts Available for Tourism and Retail Sales

There are many means for Accessible Public Charging:

- There is an Appropriate Means Available for Every Location
- WV just needs to identify which to use, where – and then **Get Started**!

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

IN CLOSING

The West Virginia Electric Auto Association is a ready resource for Information and Policy Development

Contact us via the Internet at

www.WVEAA.org

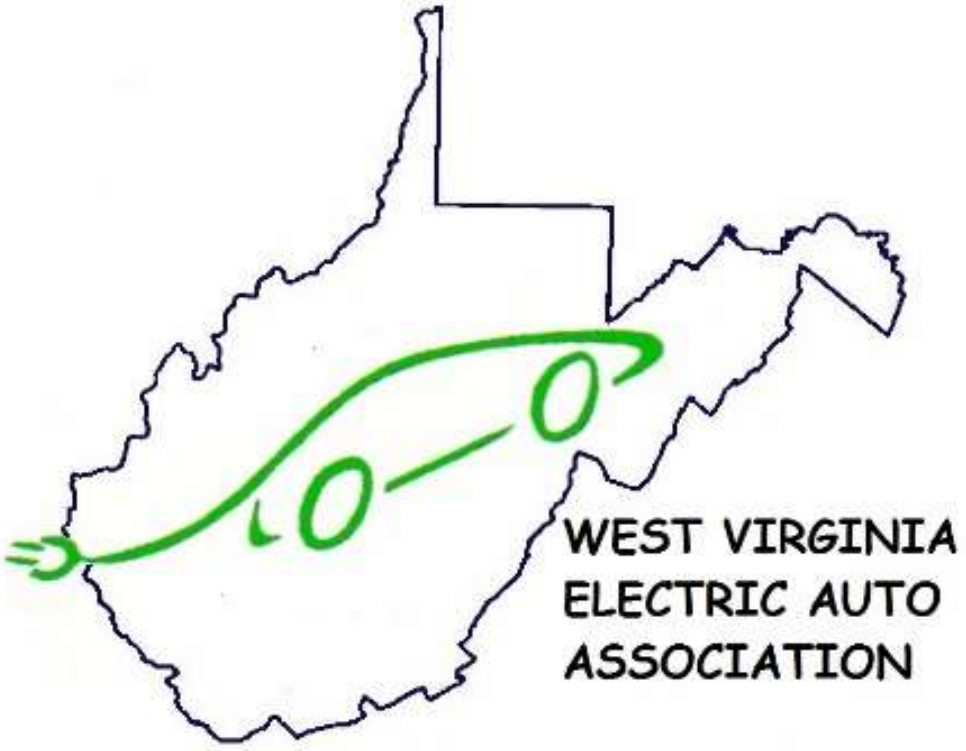
or directly at

Marty Weirick: Marty.Weirick@gmail.com
Larry Harris: lharris1@comcast.net

National Alternative Fuels Training Consortium

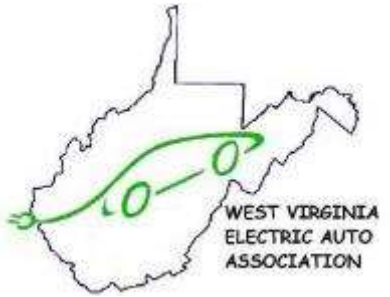
WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Electric Autos and West Virginia Energy



National Alternative Fuels Training Consortium

Background Slides



Even in the Modern Era…

GM EV-1

1996-1999

Toyota RAV4 EV

1997-2003

They've been around for
<u>OVER TWENTY YEARS</u>

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Now they are becoming among the BEST CARS on the Road

Elon Musk and Bob Lutz

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Elon Musk – Tesla Creator

Tesla Model S

Best selling US plug in car 2015 - BEV

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Bob Lutz – Father of the Chevrolet Volt

Chevy Volt

First Delivery December 2010 - PHEV

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Best Selling Plug-In in USA

Nissan Leaf

Best selling US plug-in car 2010-2015 - BEV

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Europeans coming in a BIG WAY

BMW i3 - BEV or PHEV

BMW i8 - PHEV

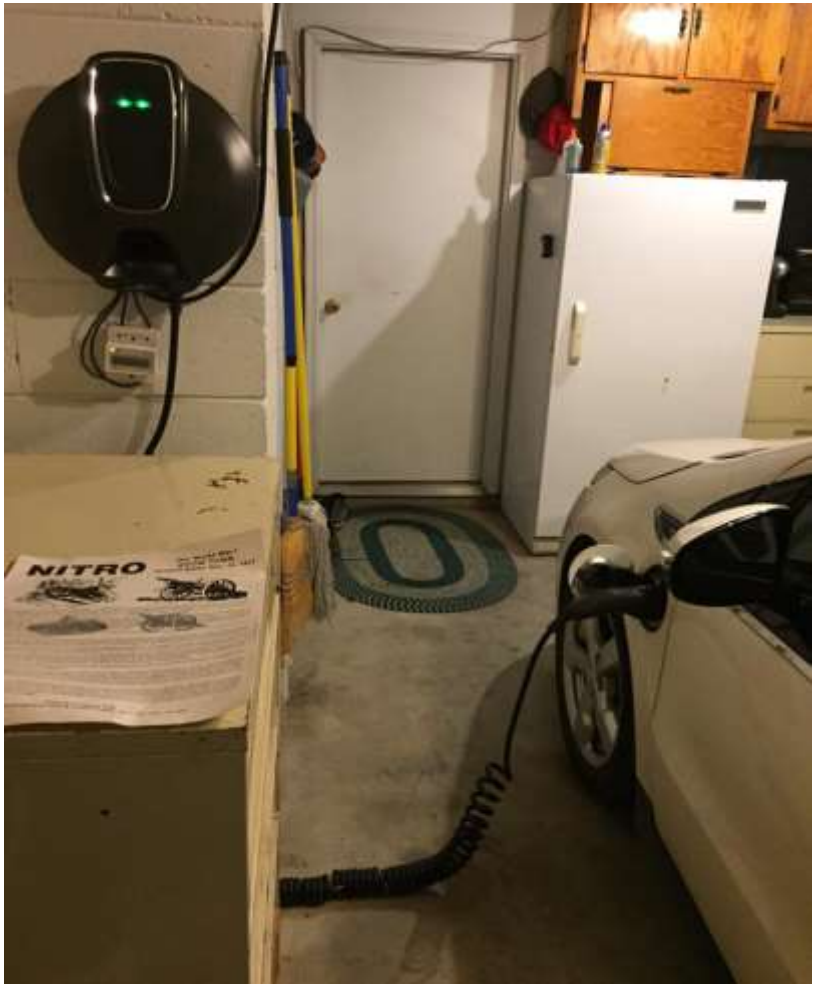
Volvo xc90 - PHEV

Even Trucks are coming soon…

VIA Motors VTRUX
PHEV

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Most EVs are Charged at Home

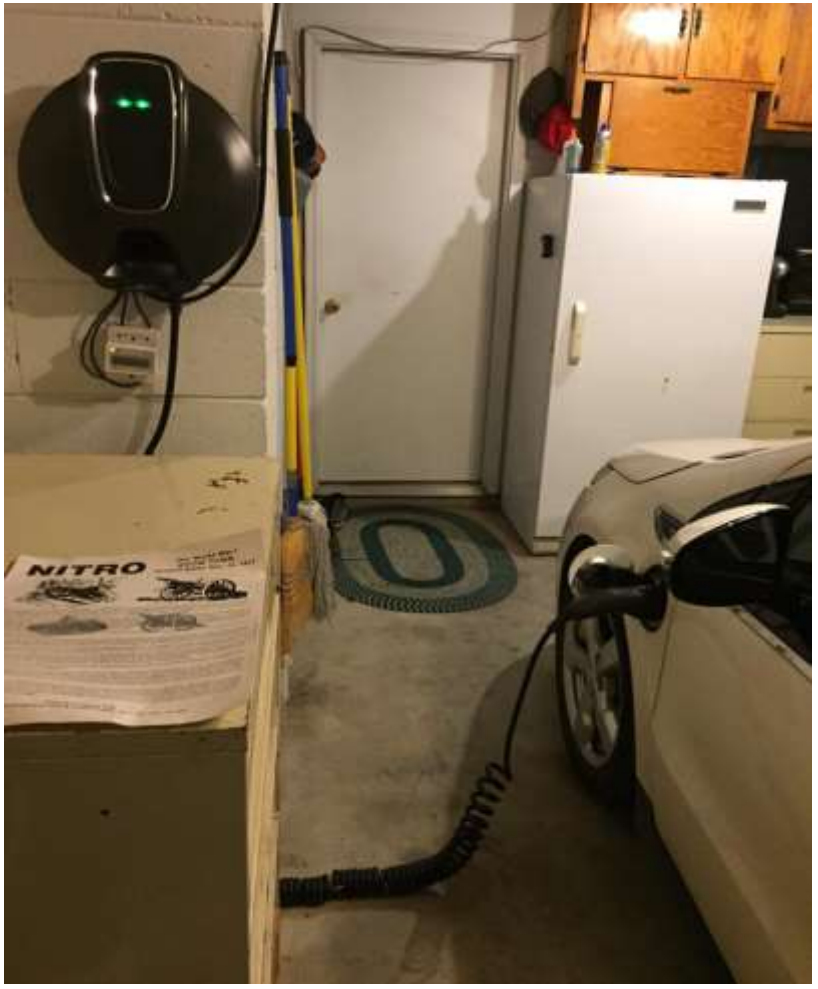


Volt Level 2 (L2) Charging Station

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Most EVs are Charged at Home

240v/13a
8 mrph



Volt charges in Four Hours

Volt Level 2 (L2) Charging Station

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Most EVs are Charged at Home

Tesla L2 Charging Station

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Most EVs are Charged at Home

Tesla L2 Charging Station – 240v/80a & 60 mrph

Tesla full charge in 4 Hours at about $10.00

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Most EVs are Charged at Home

Level 1 (L1) (110 v AC)

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Most EVs are Charged at Home

Level 1 (L1) (110 v AC)

Charges at 4 Miles of Range/Hour (mrph)

Typical Volt charges overnight for about $1.30

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

So, What's It Cost to Operate?

Running Costs per 1,000 miles

Chevy Volt:

Power: $15 - $30

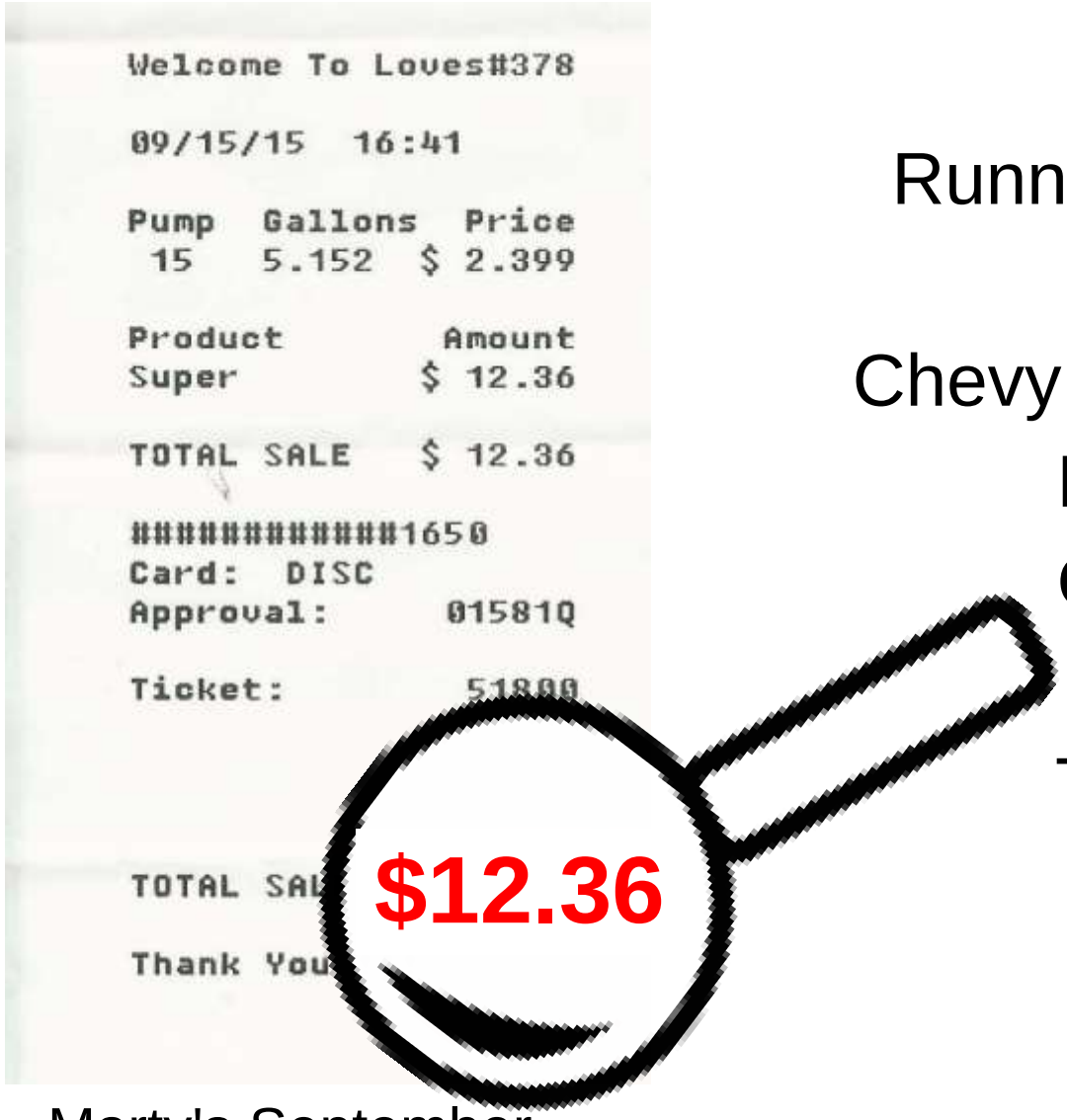
Gasoline: $10 - $30

Tesla or Nissan Leaf:

Power: $40 - $50

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

So, What's It Cost to Operate?



Marty's September Gasoline Bill

Running Costs per 1,000 miles

Chevy Volt:

Power: $15 - $30

Gasoline: $10 - $30

Tesla or Nissan Leaf:

Power: $40 - $50

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

So, Why is Electric Making a Comeback?

Nearly all current Super Cars deploy Electric Drive Capabilities

The 1500 hp Koenigsegg Regera is a hybrid with an 18 mile all-electric range

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Why should We care about electric cars?

A study showed an Average Shopper spent
12 Minutes in a Retail Store

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Why should We care about electric cars?

A study showed an Average Shopper spent
12 Minutes in a Retail Store

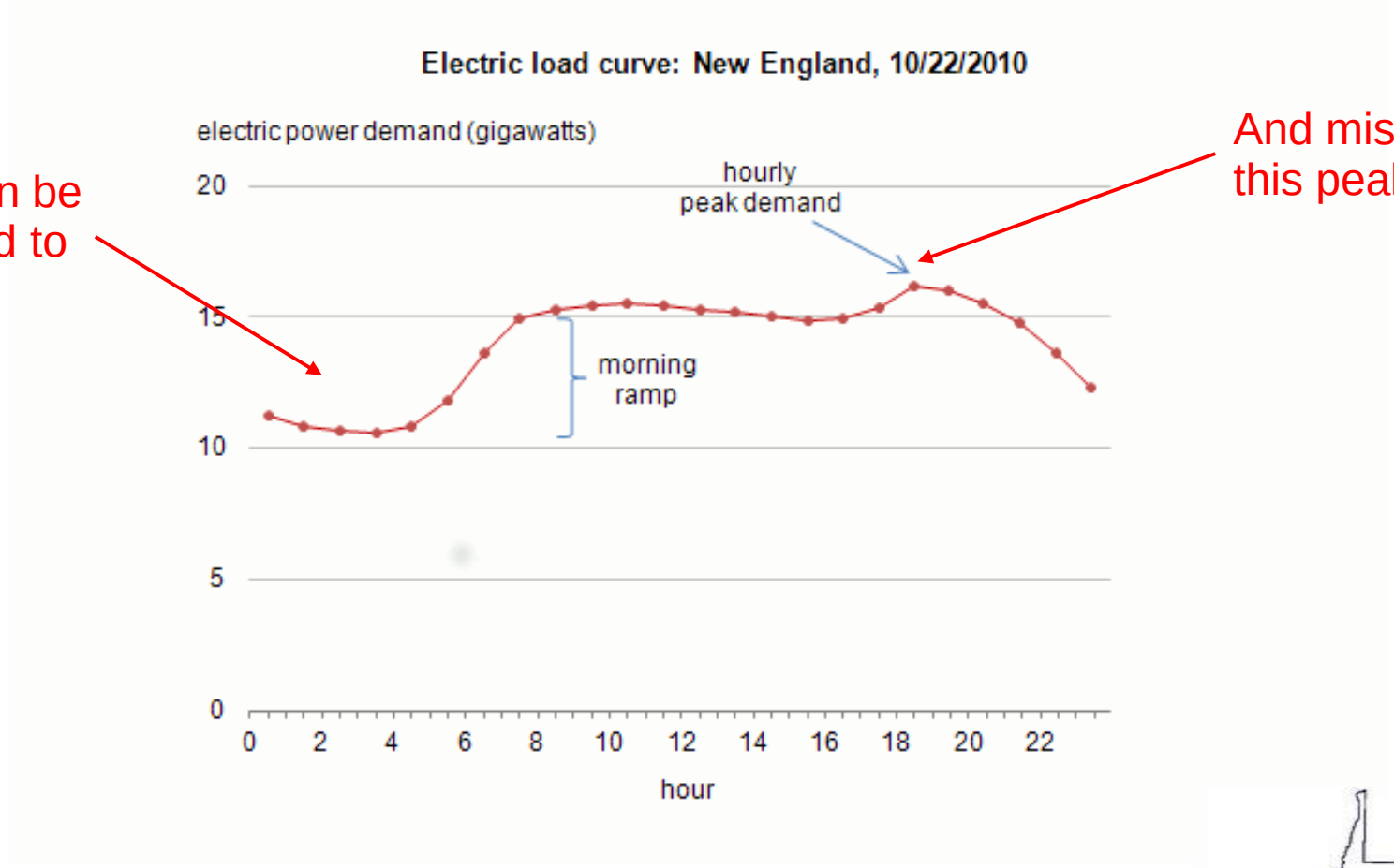
Add a Charge Station and the Study showed the
Average EV Shopper spent **45** Minutes in the same
Retail Store

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Most EVs are Charged at Home

At NIGHT!

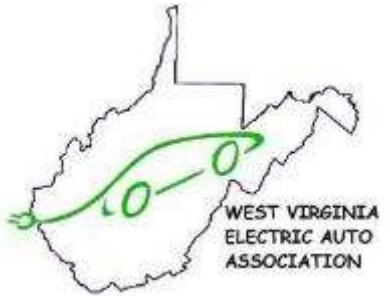
Electric car charging can be programmed to fill this dip



And miss this peak

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Say What? **100K EVs in our Region?**



Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil

EVs typically avoid burning One Gallon (or more) of gasoline a day

That’s about 500 gallons of gasoline per year.

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil – Eliminate 500 gals gas per EV/yr
  - Powered by COAL – Soon 1.5MM-2MM tons per year
- Limited Effect on Existing Power Grid

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil – Eliminate 500 gals gas per EV/yr
  - Powered by COAL – Soon 1.5MM-2MM tons per year
- Limited Effect on Power Grid – Most Charging at Night
- Market Drivers are Appealing

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil – Eliminate 500 gals gas per EV/yr
  - Powered by COAL – Soon 1.5MM-2MM tons per year
- Limited Effect on Power Grid – Most Charging at Night
- Market Drivers are Appealing
  - EVs are a Boost for Retail Sales

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil – Eliminate 500 gals gas per EV/yr
  - Powered by COAL – Soon 1.5MM-2MM tons per year
- Limited Effect on Power Grid – Most Charging at Night
- Market Drivers are Appealing
  - EVs are a Boost for Retail Sales – Shoppers stay longer
  - W.Va. Tourism needs to “Be Prepared”

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Why should We care about electric cars?

Tourism is a Driver in West Virginia

WEST VIRGINIA
ELECTRIC AUTO
ASSOCIATION

Why should We care about electric cars?

Tourism is a Driver in West Virginia

Public Charging Stations will bring Drivers to W.Va.’s Tourism Destinations

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Public EV Charging

L2

Most Common Public Station

240 volts

13 to 70 amps

ChargePoint Public Station

Charges at 8 to 55 mrph

Charging fees vary (zero and up)

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Public EV Charging

L3 Stations – Faster Charge at 480v DC

Charging fees vary (zero and up)

Charges at 25 to 150+ mrph

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil – Eliminate 500 gals gas per EV/yr
  - Powered by COAL – Soon 1.5MM-2MM tons per year
- Limited Effect on Power Grid – Most Charging at Night
- Market Drivers are Appealing
  - EVs are a Boost for Retail Sales – Shoppers stay longer
  - W.Va. Tourism – Boosted by Public Charging

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Why should We care about electric cars?

- Positive for US & W.Va. Economics
  - Reduce Imported Oil

EVs typically avoid burning One Gallon (or more) of gasoline a day

That's about 500 gallons of gasoline per year.

That is *imported oil* which has been *eliminated*!

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

Say What? **100K EVs in our Region?**

- There are **375,000** plug-in cars **NOW** in USA
- 24 models across 15 brands – Today
- More than 50 new models in pipeline
  - From GM, Ford, Nissan, BMW, Audi, VW, Mitsubishi, Volvo, Apple and others

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

West Virginia Electric Auto Association
Analysis

Question: Why should West Virginia care about electric cars?

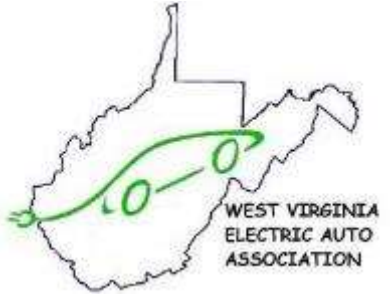
Answer: Imported Oil Electric cars use electricity from the US grid. Based on average assumptions, electric cars avoid burning more than 1 gallon of gasoline a day, or about 500 gallons a year. Because the US is a net oil importer, this avoided fuel is imported oil.

What if we replaced oil imported from our enemies with West Virginia coal?

West Virginia Electric Auto Association
Analysis

Question: Why should West Virginia care about electric cars?

Answer: US Economics One million electric cars will defer burning 500,000,000 gallons of gasoline per year. Based on $40 / barrel oil, that reduction in oil imports will reduce the US balance of payments more than $0.5 billion per year.



West Virginia Electric Auto Association
Grid Analysis

Question: Won't electric cars overwhelm the electric grid, requiring huge new investments?

Answer: Not necessarily. Think of an EV as a computer with wheels. Every EV can be programmed for at least charging in 3 modes:

1) Set charge start time.

2) Set charge completion time.

3) Set time of day charge cost table, and the car software optimizes charging times.

West Virginia Electric Auto Association
Market Analysis

Electric Car Market Share Barriers

- Cost of Cars
  - Declining – think computers & flat screen TVs
- Availability of public car charging stations
  - Most charging is at home but public charging is needed for long trips
- Political opposition
  - Electric cars have a “green” tint
- Most gas cars work well

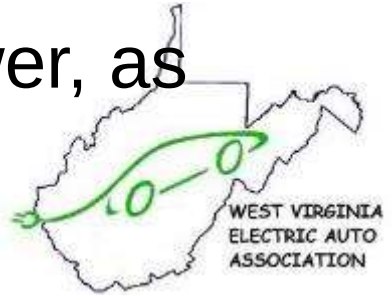
WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

West Virginia Electric Auto Association

Retail Charging Analysis

What benefits can go to retail business for public charging?

- At a California department store chain the average shopper stays 12 minutes.
- At the same chain the average EV owner stays 45 minutes.
- EV owners are loyal retail customers, and will drive out of their way to find merchants that provide public charging.
- EV owners are willing pay for the power, as long as they don't feel gouged.



West Virginia Electric Auto Association

Public Charging

- Although EV's are mostly charged at home, most owners (especially battery only owners) want the assurance they can charge away from home if they need to charge to get home.
- Home charging is unlikely to meet all EV owner needs.
- West Virginia and the region have experienced very slow rollout of public charging stations compared other parts of the US.

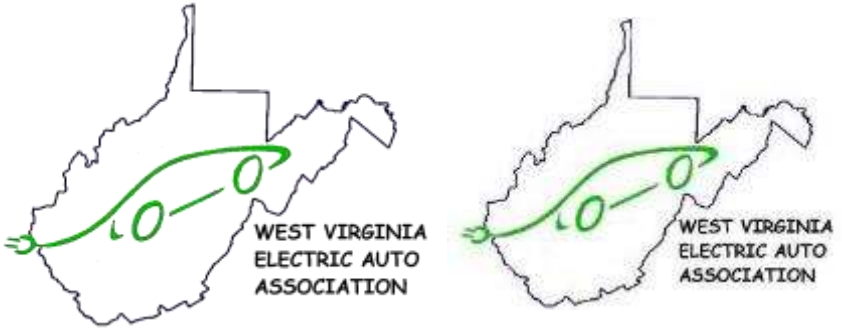
WEST VIRGINIA ELECTRIC AUTO ASSOCIATION

West Virginia Electric Auto Association SUMMARY

Policy Analysis

WVEAA has policy recommendations to help the electric car market.

- Build-out of networked charging stations
- Time-of-use electric power pricing
- Auto Dealers need to sell electric vehicles



Electric Autos and West Virginia Energy

Questions or Comments?

Governor Tomblin's ENERGY Summit
West Virginia: A National Energy Resource

WEST VIRGINIA ELECTRIC AUTO ASSOCIATION