



Green Power for Sustainable Transportation

Northeast Seattle Neighbors' Sustainability Network

24 June 2010

6:00 - 7:30pm

Presented by Tracy Farwell



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This information is provided
only for independent verification.



Choices you can make this year

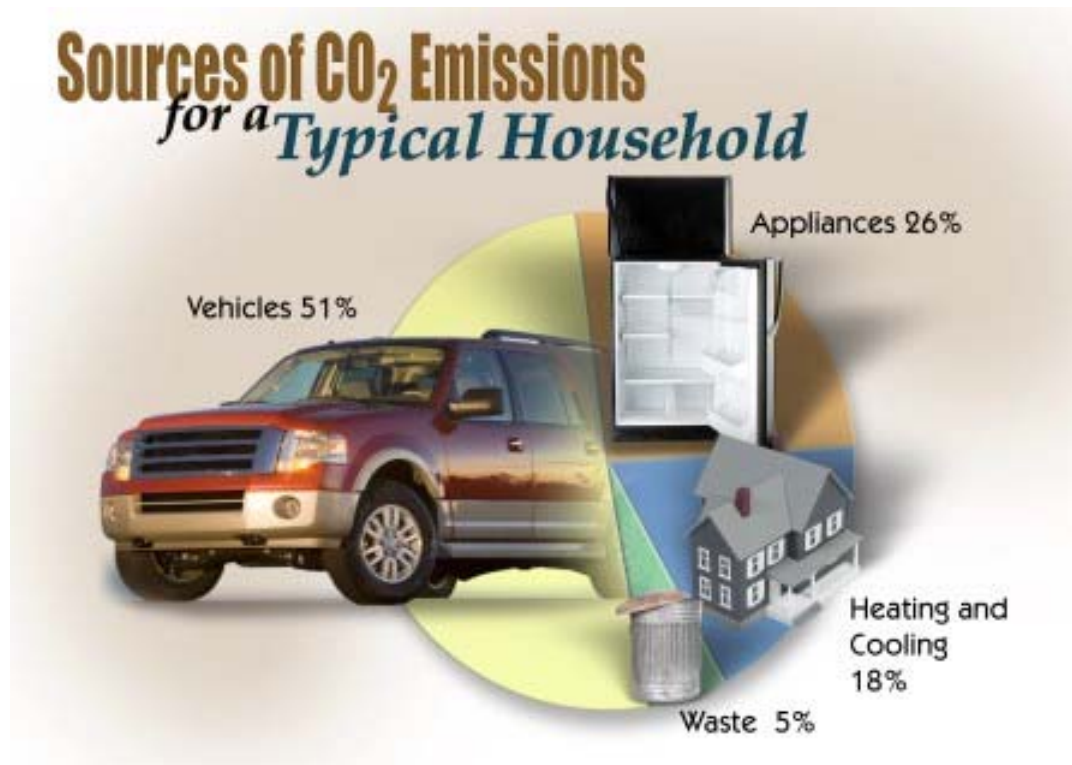
- Reduce household carbon footprint by 50%
- Achieve zero emissions for commuting
- Eliminate fuel costs, zero net energy annually

Energy Choices 2010



Choices you can make this year

- Reduce household carbon footprint by 50%



Appliances	26
Heat & Cool	18
Waste	5
	49

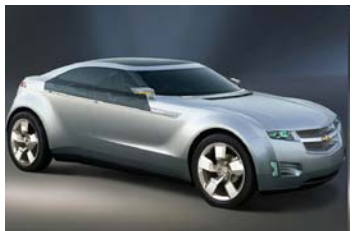
<http://www.fueleconomy.gov/feg/climate.shtml>

Energy Choices 2010



Choices you can make this year

- Achieve zero emissions for commuting



EV	Battery Size	Full range	Motor effect at full range [Mi/kWh]
Nissan Leaf EV	24 kWh	100 mi	5.2
Ford Focus EV	23 kWh	80 mi	5.4
Chevrolet Volt - elec	16 kWh	40 mi	3.1
Fisker Karma - elec	22 kWh	50 mi	2.8
Tesla Roadster EV	53 kWh	244 mi	5.7

Energy Choices 2010

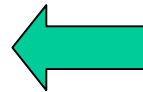


Choices you can make this year

- Eliminate fuel costs
- Zero net energy annually

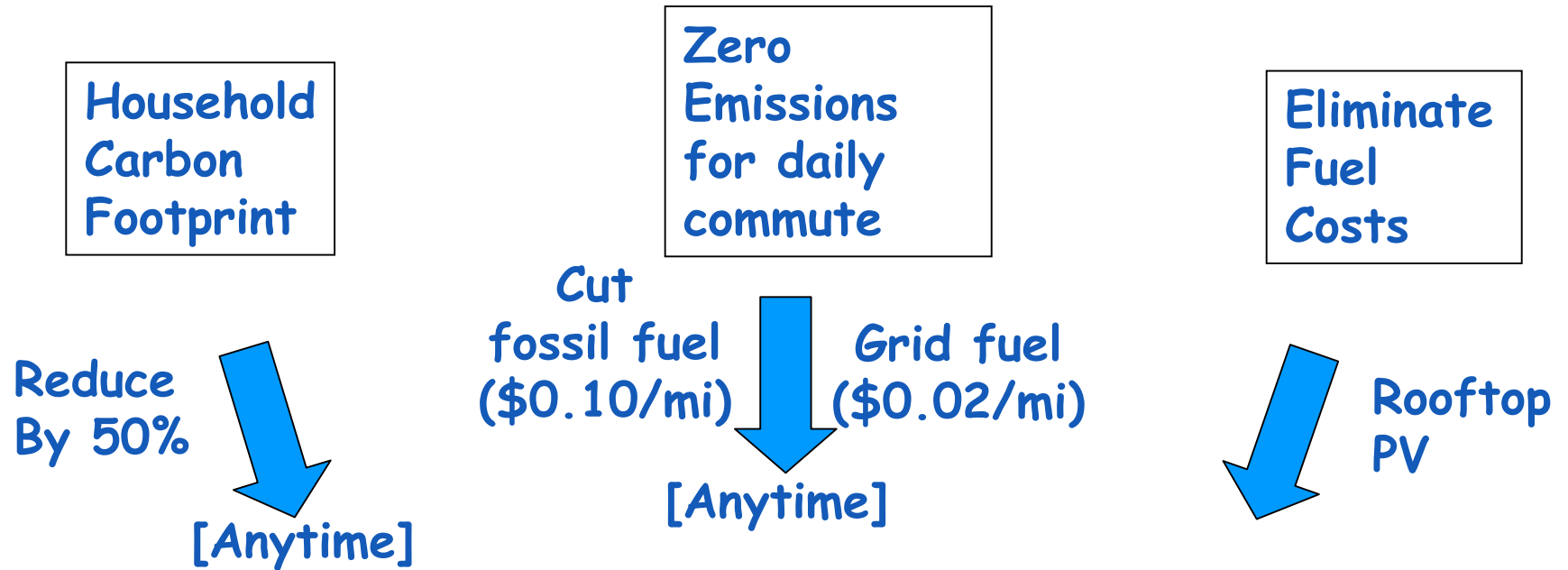


Nissan Leaf in Seattle, 2009



Design rooftop PV to match annual energy needs for EV charging: 2.5 kW installation produces 2380 kWh per year, for 10,000 miles driven.

Energy Choices 2010



One solution

Energy Choices 2010



Household
Carbon
Footprint

Zero
Emissions
for daily
commute

Eliminate
Fuel
Costs

Reduce
By 50%



[Anytime]

Cut
fossil fuel
(\$0.10/mi) Grid fuel
(\$0.02/mi)



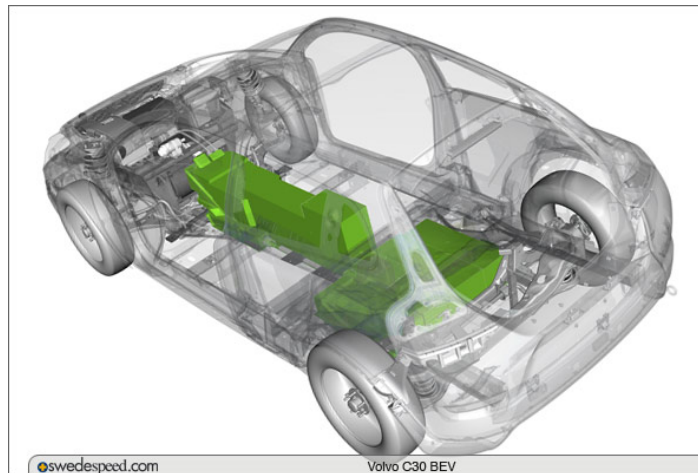
[Anytime]



Rooftop
PV

[2 years]

The Electric Drive
Vehicle (EDV)
answers all three
goals



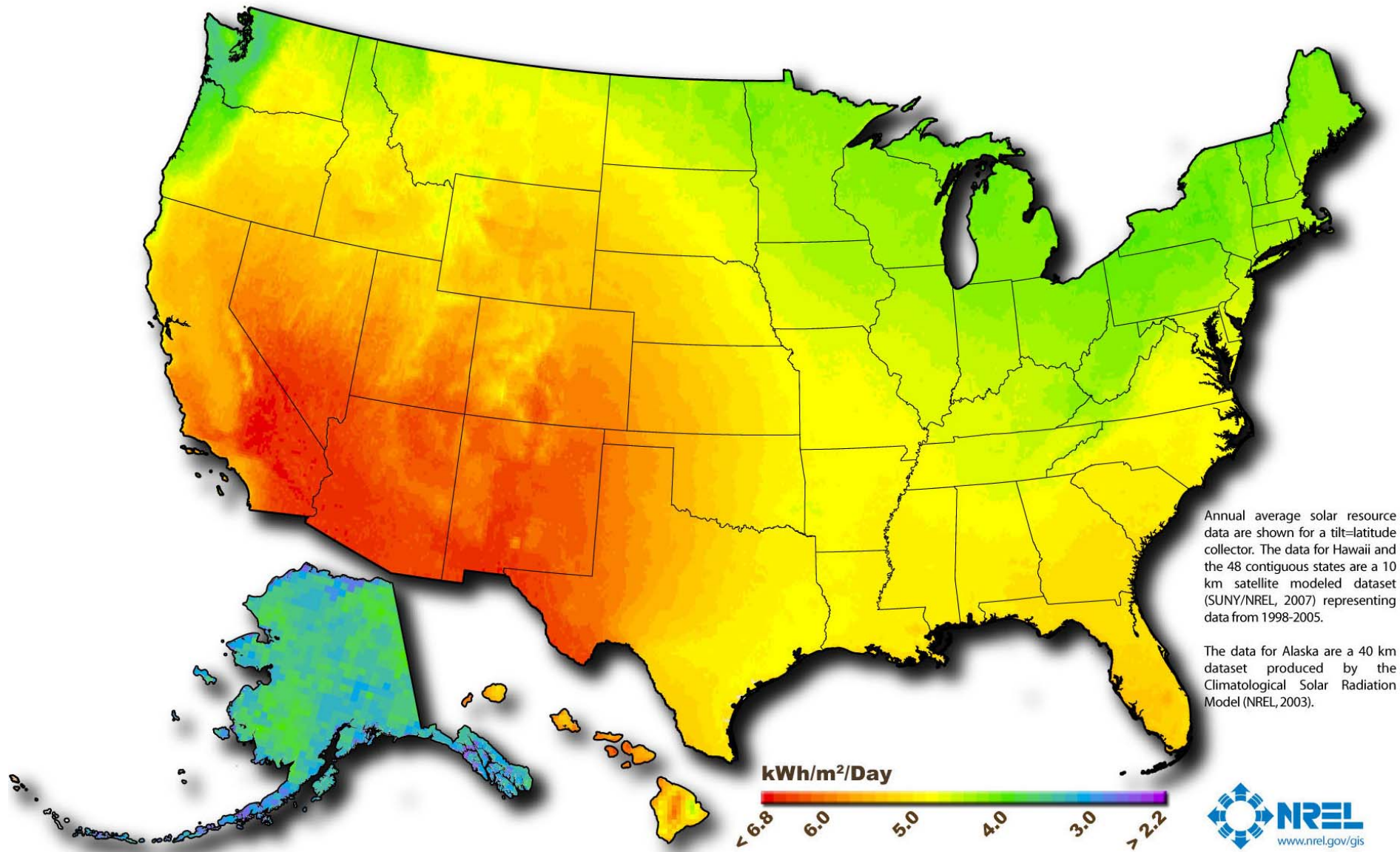
PV Cost
Recovery
takes 7
yrs in
Seattle
(6 yrs in
Portland)

Energy Choices 2010



	Internal Combustion	Electric Drive Vehicle
Motor Efficiency	1	x4
MPG	1	(x4)
Emissions	1220 mi/ton CO2	None
Motor fuel	Fuel to transport fuel	Rooftop PV
Fed/State Investment Incentives	No (fuel taxed)	Yes (no fuel tax)
Family Vehicle Cost Recovery	No	No
Business Vehicle Cost recovery	Yes (depreciation)	Yes (depreciate, including PV)
Fuel Source Cost Recovery	N/A	WA, 7yrs - residential OR, 6 yrs - residential NY, 6 yrs - residential

U.S. Photovoltaic Solar Resource



Author: Billy Roberts - October 20, 2008

This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.



Federal incentives provide 30% of cost as tax credit

- ARRA

<http://www.irs.gov/newsroom/article/0,,id=211307,00.html>

In WA State, Energy from PV earns income when sending it to the power grid

- Residential and business energy payments in WA are credited at \$0.54 /kWh for PV components manufactured in WA (no state provides more energy credit)
- When using other components, credit is \$0.15 /kWh

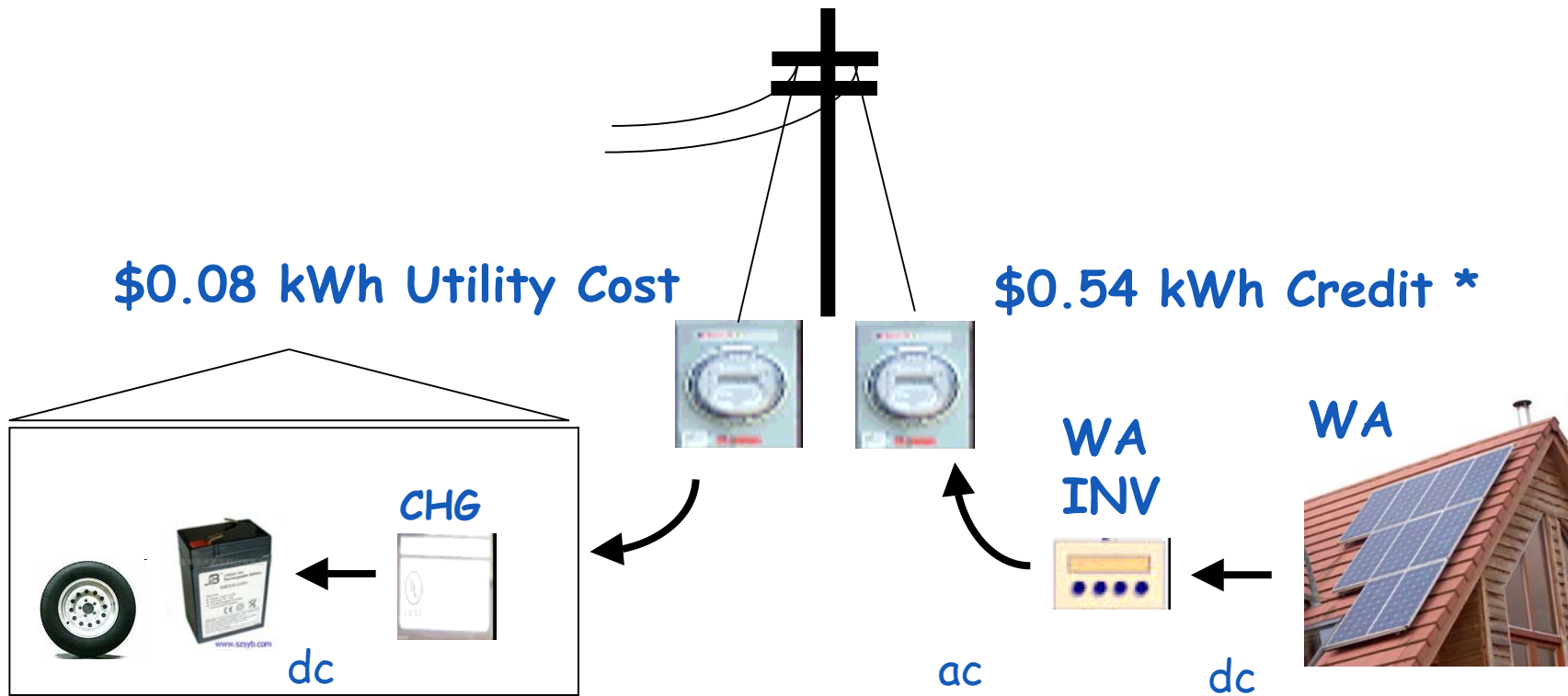
Typical PV installation designed to provide full annual charging for an Electric Drive Vehicle (EDV) collects 2500 kWh yearly

- Assumes 10,000 mi per year
- This corresponds to a solar capability of 2.5 kW
- At \$8 / watt for WA components, total cost is \$20,000

Economic Advantages for WA Solar



Energy sent to the grid earns a premium



* Under terms of WA SB 5101, May 2005

Early Cost Recovery for Photovoltaic (PV) Installations



\$20,000 reduced by 30% is \$14,000

The annual energy usage of 2500 kWh, credited at \$0.54/kWh, calls for an annual income of \$1350 (not taxed)

- Investment of \$14,000 is recovered in 10.4 years
- WA State incentive expires in June 2020
- Lifetime of PV panels is 30+ years

Multiples of 2.5 kW increase annual income

- Max allowable energy income is \$5000 annually
- Payback is still 10.4 years



Payback improves if the energy is used to power an EDV

- An EDV travels 5.2 mi per kWh consumed
- Assume an energy cost of \$0.08/kWh
- This converts to $\frac{\$0.08/\text{kWh}}{5.2 \text{ mi/kWh}} = \$0.015/\text{mi} = \$0.02/\text{mile}$

For the typical 30 mpg vehicle, and \$3/gal, fuel cost is \$0.10/mi

- For annual usage of 10,000 mi, total cost is \$1000

With fuel costs savings of \$800 per year, payback is accelerated

- EDV savings (\$800) plus PV income (\$1350) totals \$2150
- Investment of \$14,000 is now recovered in 6.5 years



Additional costs delay cost recovery

PV inverter cost is \$1500.

If your cost recovery accounting includes other expenses, payback can take longer

- Cost to finance \$14k loan
- EV charging dock cost is \$2000.
- Upgrading your electrical panel from 125A to 200A can cost \$4000 (homeowner to have underground conduit installed)

Even with 10 year cost recovery, PV panels produce for 20 more years

Early Cost Recovery for EDVs



Commuter vehicles have never been regarded as a source of income

- Cost recovery for commuter vehicles is unprecedented
- Lexus payback ? Hummer ? 600 hp Mercedes S63 ?
- Even so, EDV tax rebate is \$7,500 under the EESA

<http://www.irs.gov/newsroom/article/0,,id=211307,00.html>

Commercial EDVs themselves can be written off as depreciated investments

- With 5 year accelerated depreciation, commercial EDVs and their rooftop PV can have total combined investment cost recovered in 6 years
- Thereafter, both Vehicle and Fuel at no cost

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- With 5 year accelerated depreciation, commercial EDVs and their rooftop PV can have total combined investment cost recovered in 6 years
- Thereafter, both Vehicle and Fuel at no cost - **unprecedented**

There's more to know about EDVs



New skills and knowledge are needed for EDV ownership

Battery care and feeding for lifetime performance

- 70% to 80% discharge maximum

- Li-Ion traction batteries last 8-10 years

- Cost is balanced by net fuel savings of \$800/yr

Unattended charging - safe enough ?

Owner maintenance and repair

- Toolbox - insulated hand tools

- Skills - electrical

- Traction battery safety - know the technical risks

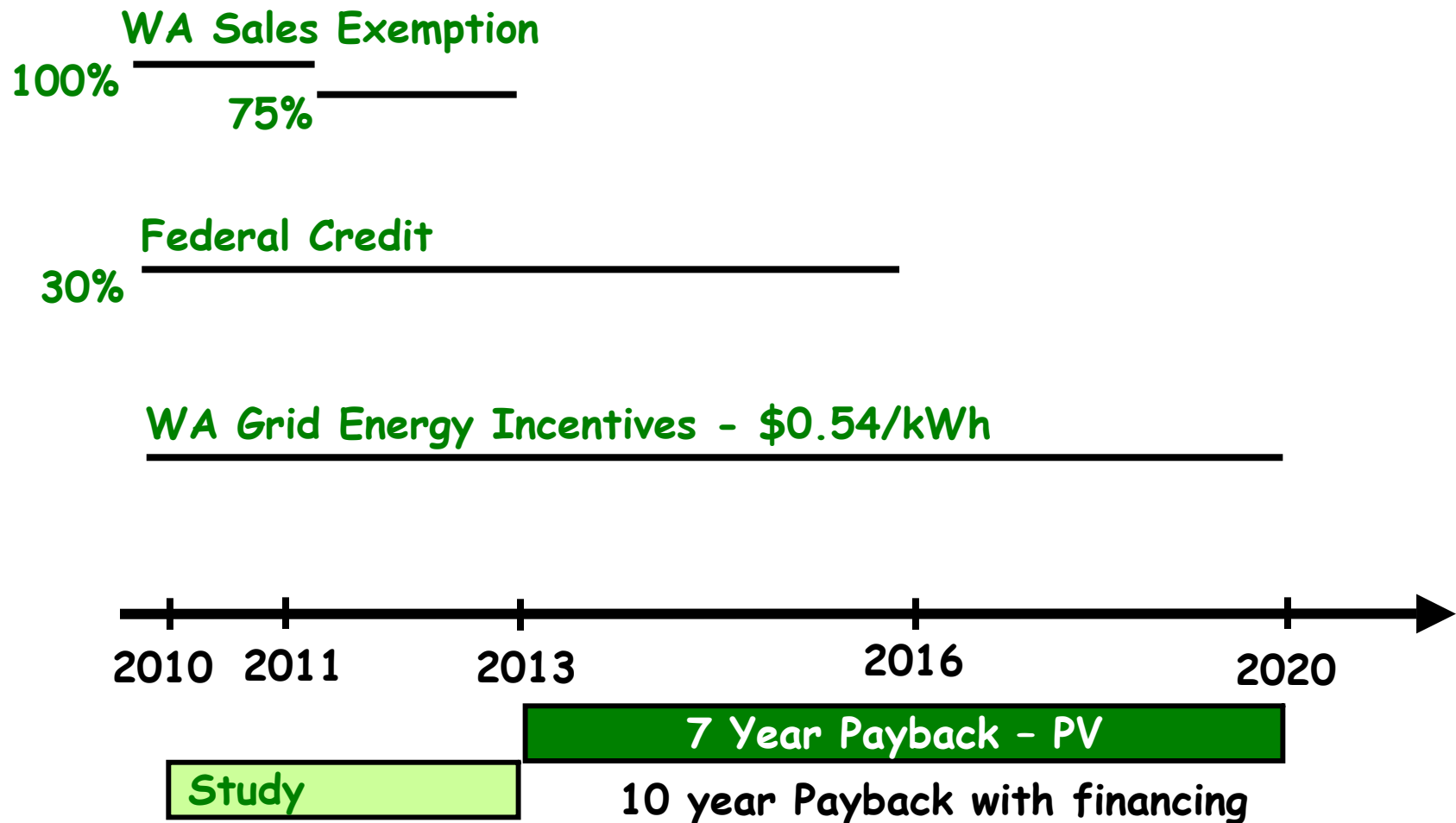
 - Beware of any voltage > 35 VDC

PV incentives are temporary



Washington SB 5101, May 2005			
	Incentive	Amount	Expires
Federal	Tax Credit	30% of total cost	12/31/2016
WA State	Sales Tax Exemption	100%	6/30/2011
	Sales Tax Exemption	75%	6/30/2013
WA State [\$5000 / yr Max]	Grid Energy Credit	WA PV Panels \$0.36 / kWh	6/30/2020
	Grid Energy Credit	WA Inverter \$0.18 / kWh	6/30/2020
	Grid Energy Credit	PV Panels \$0.15 / kWh	6/30/2020

Incentives Don't Last Forever



Incentives are predictable



WA energy strategy

- Maintain competitive energy prices
- Increase competitiveness by fostering a clean energy economy and jobs through business and workforce development
- Meet the state's obligations to reduce greenhouse gas emissions.
- Assistant Director, WA Dept of Commerce

Tony Usibelli

Renewable Energy incentives

- WA is exceptional for policy stability
- WA Clean Energy Leadership Council

Marc Commings



Solar Panels

Silicon Energy - Arlington, WA

http://www.silicon-energy.com/Silicon_Energy/Welcome_to_SiE.html

Grid-tied Inverters

Outback Power

<http://www.outbackpower.com/products/>

Out-of-State Manufacturers



Seattle PV Installers favor other manufacturers

- Less weight
- Smaller footprint - more kWh per sq ft
- \$4/watt (2.5 kW installation becomes \$10k - 30%)

Grid energy credit is \$0.15/kWh

- This is about $\frac{1}{4}$ the in-state credit
- \$800/year fuel saving accelerates payback
- Less cost if financed

Out-of-State Manufacturers



These cost models are designed to allow Seattle PV Installers to quote better pricing and payback.

Payback occurs sooner if something happens:

- Current mpg < 30, or usage > 40 mi/day
- Increase in Cost of fuel
- Increase in Cost of grid energy

PV Summary



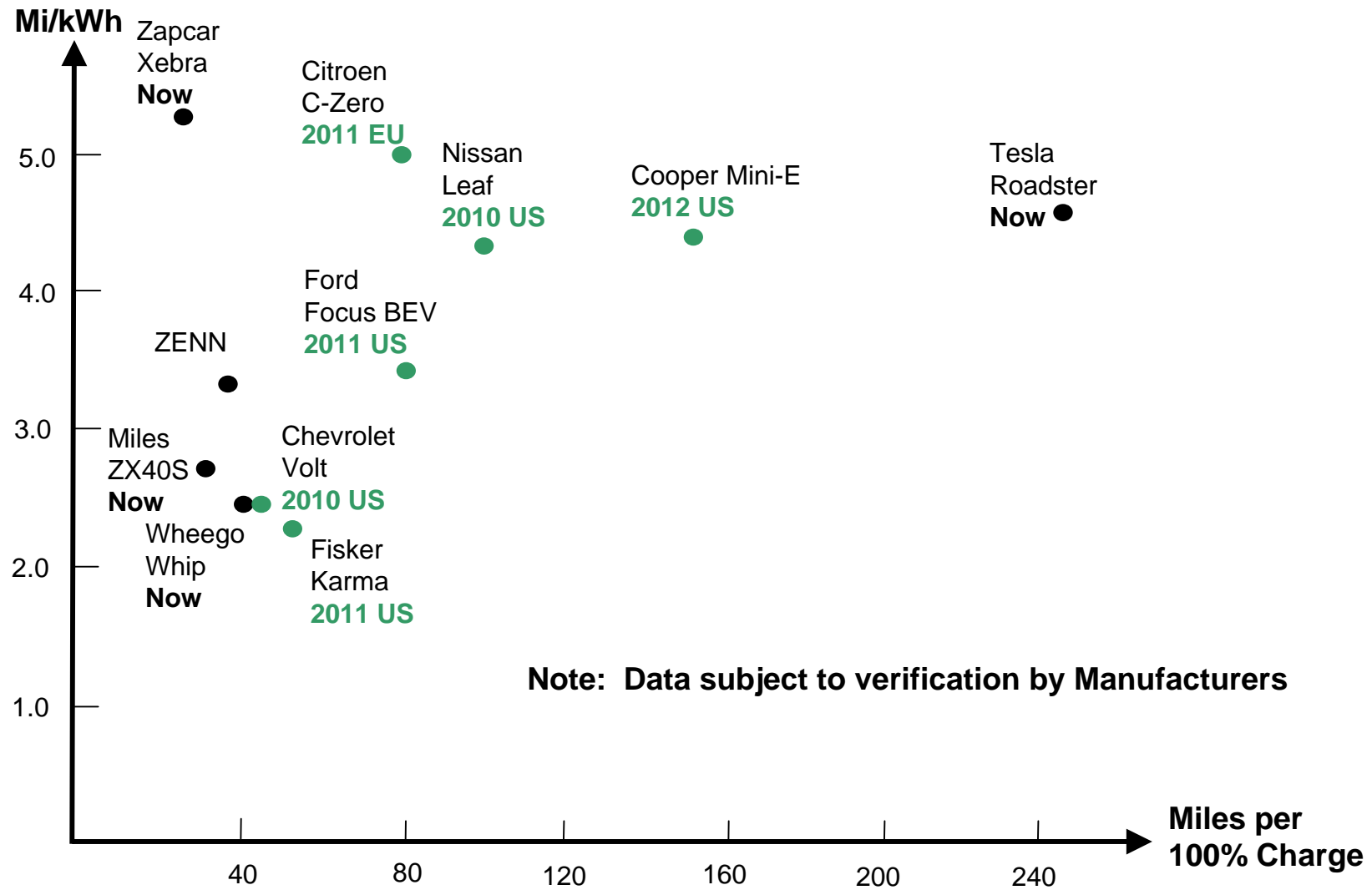
Each 1 kW PV installation, tied to grid

- Costs \$4500-\$7500 installed, after rebates
- Occupies 70 to 90 sq ft
- Produces about 1000 kWh/yr in Seattle

About Electric Vehicles



EV Energy Needed



Note: Data subject to verification by Manufacturers

State Energy Mandate - Long Term



Washington I-937 (2006)

Compliance required regardless of utility need.

Amount of Renewables based on annual retail load:

- 3% by 2012
- 9% by 2015
- 15% by 2020

Utilities must acquire:

- Renewable Energy Credits (REC), and/or
- Eligible Renewable Resources (MWh)

Eligible Renewable Resources
• Wind
• Solar
• Geothermal
• Incremental Hydro
• Biomass
• Landfill Gas
• Ocean (wave, tidal)
• Bio Diesel

Solar Carport



Solves the roof orientation problem
More portable than residential installation
Detached from living space



<http://ecopowernw.com/products-services/solar/>

Solar Trailer



Solves the roof orientation problem

More portable than carport

Detached from living space

Multiple uses

Batteries and components
occupy a small fraction
of interior



<http://www.alternativemobilepower.com/>



Owner investment from savings or energy loan.

- Cost recovery followed by 20+ years of residential energy production
- Owner receives Federal tax credit and WA incentives

PACE Loan

- Bond is financed by investment co. or public issue
- Loan repayment over 20 year term
- Billed to owner as a tax lien on tax bill

<http://pacenow.org/>



Installer financing

- Sign Power Purchase Agreement (PPA)
- Lease space on roof then install panels
- Installer owns, monitors, services panels
- Energy cost is capped by contract for specified term below current cost
- Installer receives incentives
- Installer benefits from depreciation (residential owners do not qualify), benefiting the homeowner.

<http://www.solarcity.com/residential/solar-lease.aspx>

Working With Utilities



Utilities must manage supply and demand
Supply from PV must be used locally, feeding loads on
your service transformer

- Identify transformer – Interconn Agreement
- Identify amount of energy supplied, equipment used
 - Production Agreement
- Electrical Permit, Inspection
- WA State Certification
- Application for WA Incentives

Is PV-to-EV a Sustainable Concept ?



- Available (Production)
- Renewable (No fossil energy)
- Scalable (Expand to needs)
- Adaptable (Solar geometry)
- Compatible (Environment)
- Safe (No critical hazards - EV)

- Affordable (No tax)
- Affordable (Cost recovery)
- Affordable (W/o incentives)



Mission:

Advocate for efficient distributed energy generation as well as early adoption of clean energy transportation for homes and businesses. Help the solar industry grow by providing accurate prediction of cost trends and performance.

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