

Washington State DOT's Public/Private Partnership for the I-5 Electric Highway Project

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Introduction: The Transportation-Energy Imperative

- 1** Electric Vehicle Basics
- 2** Why DOTs Should Help Transition Vehicles to the Electric Power Grid
- 3** WSDOT's West Coast Green Highway Initiative
- 4** Supportive State Actions

U.S. oil dependence weakens our national security, threatens our economy, and degrades the environment.

National Security Costs of Oil Dependence:

- As the largest consumers of oil in the world, the U.S. bears the burden of securing global supply lines and infrastructure, using military force if required. *Annual cost: \$67.5 billion to \$83 billion per year.*

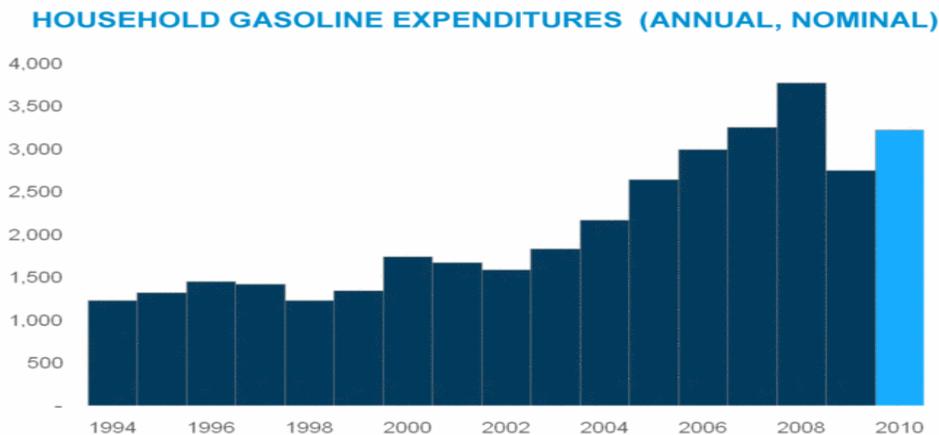


- American diplomacy is distorted by our need to minimize disruptions to the flow of oil, constraining our foreign policy options on uranium enrichment, hostile regimes and humanitarian issues.

Economic Costs of Oil Dependence:

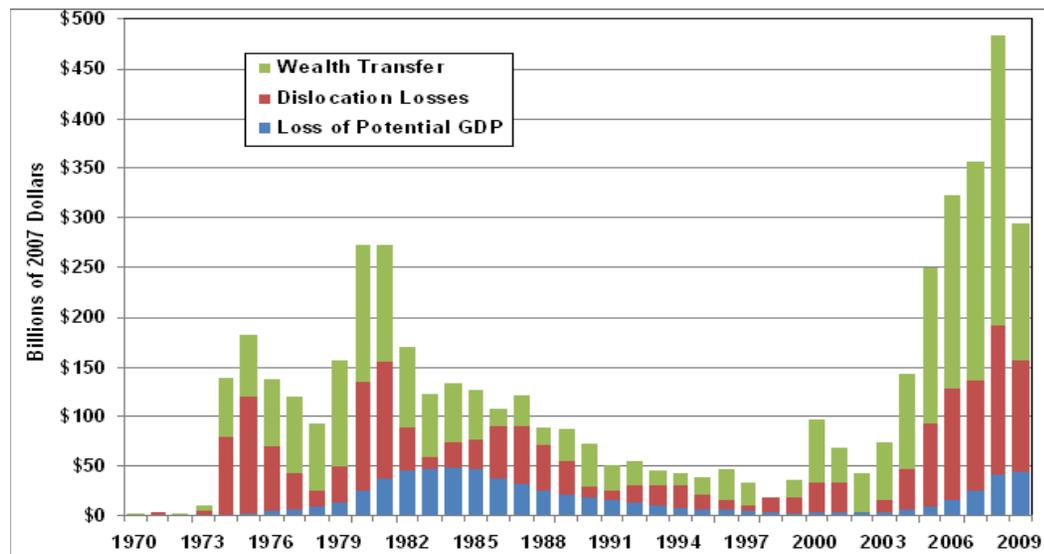
- Every recession over the past 35 years has been preceded by – or occurred concurrent with – an oil price spike.
- Economic dislocation: when oil prices fluctuate, long-term budgeting and investment is difficult for households and businesses, and economic activity is significantly curtailed.

US Oil Dependence: Economic Costs



Economic Costs of Oil Dependence:

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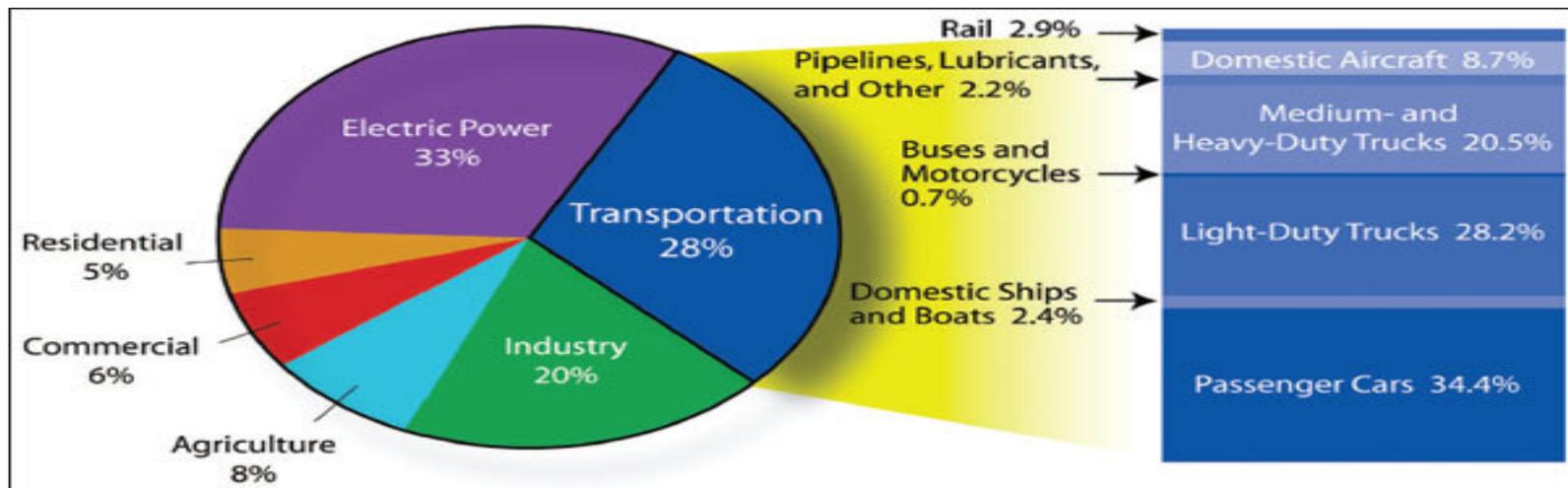
Environmental Costs of Oil Dependence:

- The transportation sector is the single largest end-use emitter of carbon dioxide in the U.S (34 percent of total CO₂ emissions).
- To reach a 450 ppm Co₂ stabilization target, by 2030 more than 60 percent of new vehicle sales must be electric drive.



Environmental Costs of Oil Dependence:

- Total domestic emissions from petroleum were 2,580 million metric tons (43 percent of total emissions). 70 percent of this is from transportation.
- Passenger and light-duty vehicles constitute 62 percent of the transportation sector's GHG emissions.



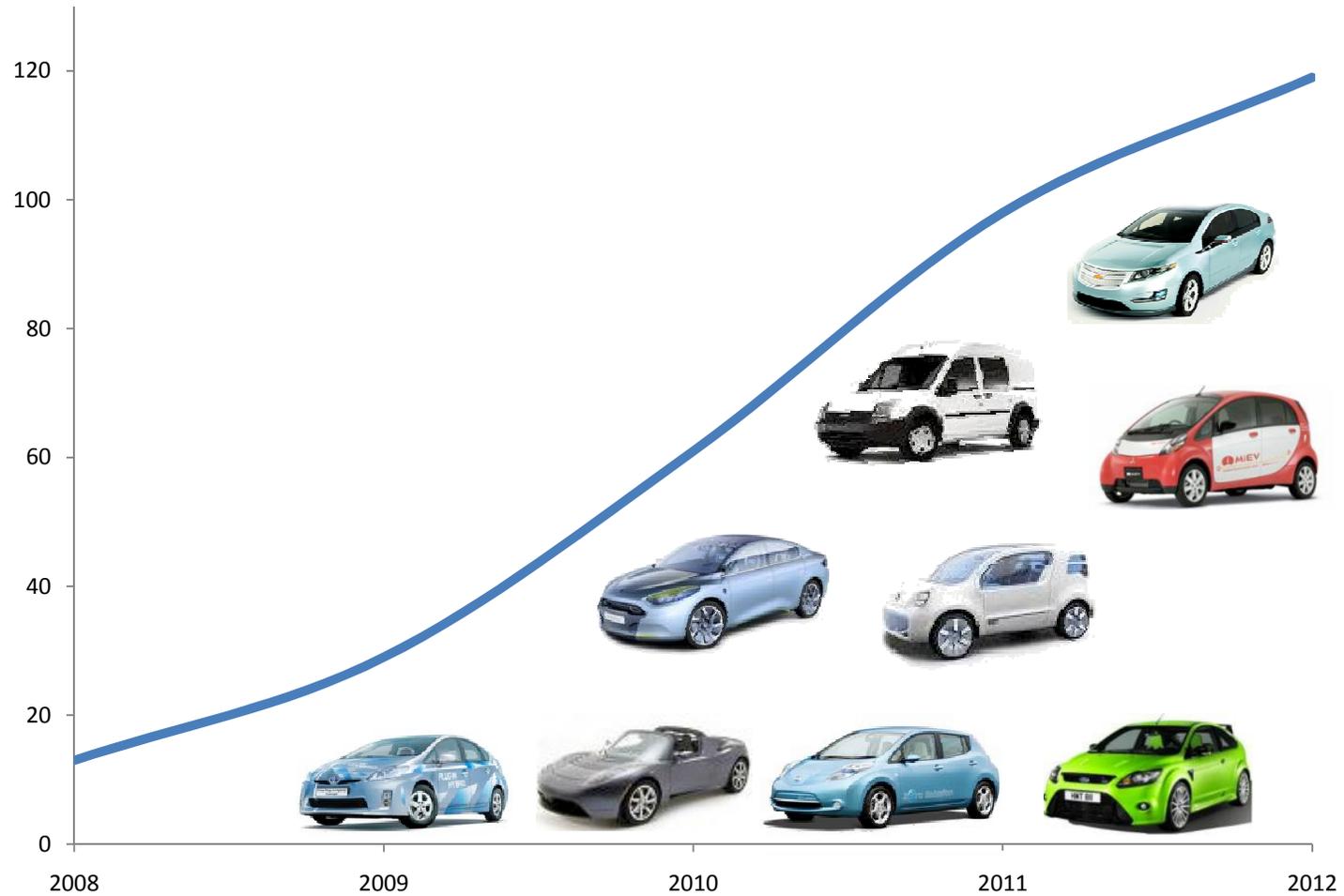
U.S. Co2 emissions, by sector (2007)

Electric Vehicle Characteristics:

- Instant and smooth acceleration
- Quiet (inside and out)
- Minimal maintenance
- Efficient energy usage
- Zero tail-pipe emissions



Electric Vehicle Models



Electric Vehicles: Battery Electric (BEV) vs. Plug-in Hybrid (PHEV)



Example: Nissan LEAF

- All Electric Range: 60 - 200 Miles, depending on battery size
- Level 1 (120 v), Level 2 (240 v) and optional Fast-Charging (480v)
- Target markets:
 - Urban Commuters
 - Second Car in Every Home
 - Eventually: all-purpose



Example: Chevy Volt

- Battery Electric plus ICE range extender
- 10-40 mi all-electric, 200-300 mi gas
- Level 1 (120v) and Level 2 (240v) Charging
- Target Market: all automotive applications

Nissan LEAF Range and Vehicle Efficiency

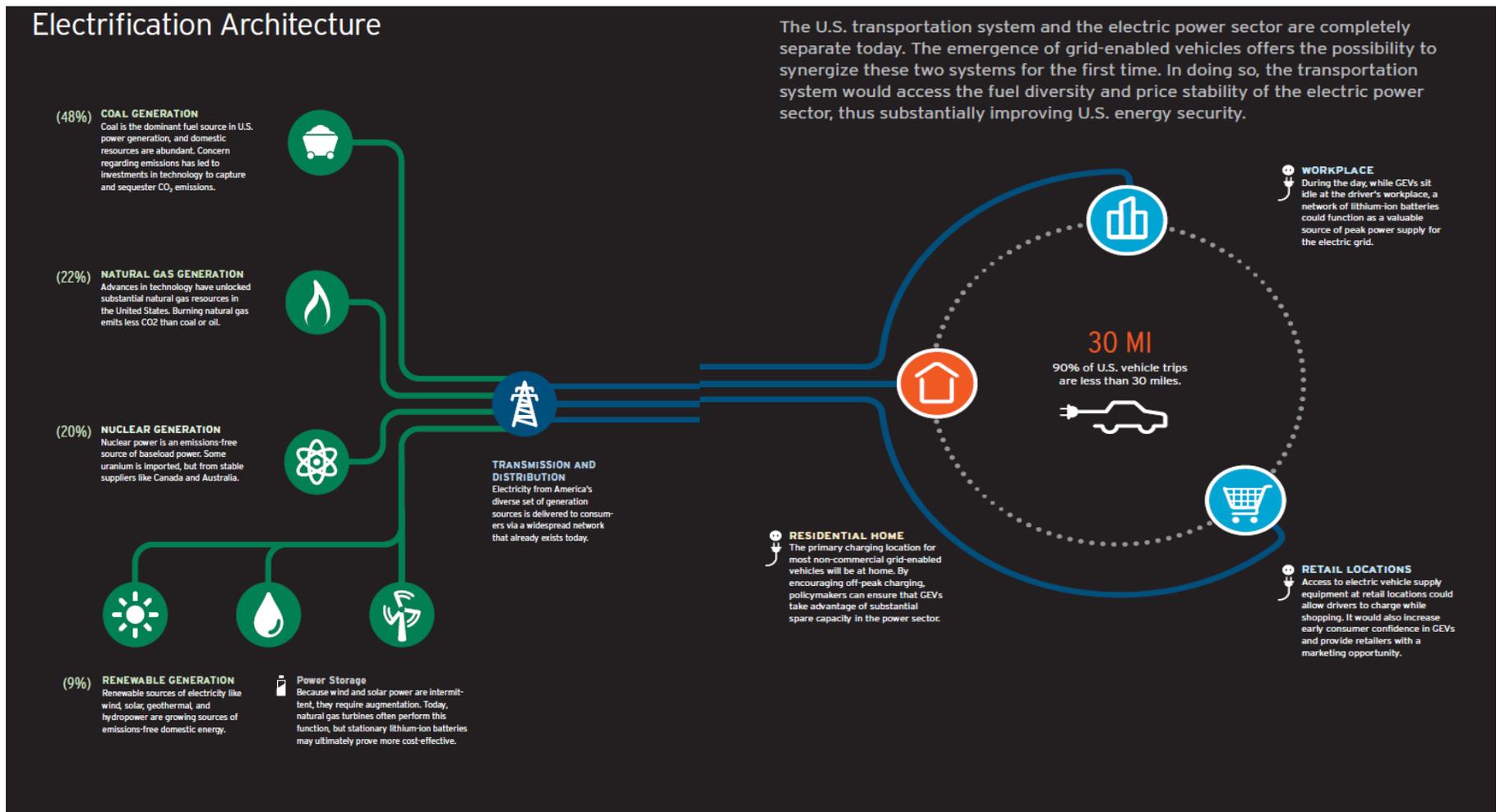
Speed and Driving Conditions	Outside Temp (F)	Accessories	Estimated Range (mi)	Vehicle Efficiency (mi/kWh)*
Cruising 38 mph	68°	None	138	5.75
Fairly steady 24 mph City traffic	77°	None	105	4.38
Steady 55 mph Highway	95°	A/C on	70	2.91
Crawling 15 mph Stop-and-go	14°	Heater on	62	2.60
Average 6 mph Heavy stop-and-go	86°	A/C on	47	1.96

Nissan LEAF has a 24 kWh battery

Source: "Nissan Agrees - EV Mileage Will Vary; Leaf Tests Show 91-Mile Variation." Green Car Advisor – edmunds.com. June 15, 2010.

Fuel Source: Electric Power Grid

Grid-Enabled Vehicle System Architecture (source: Electrification Coalition)



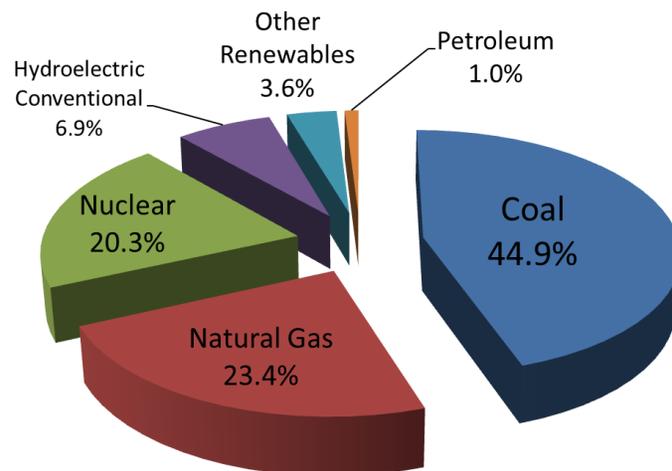
Fuel Source: Electric Power Grid

Advantages:

- Diverse and domestic
- Prices are stable
- Substantial spare capacity

- Network infrastructure already in place
- Electric miles cheaper than gas
- Electric miles are cleaner than gas
- 65 percent of present U.S. light-duty vehicles could be powered by existing off-peak generating capacity

2009 U.S. Electricity Generation by Source



Fuel Source: Electric Power Grid

Managed Charging Reduces Costs and Risks to Utilities

Projected grid Impacts of 2 million electric vehicles				
Israel Electric Co. (2008)	Additional Generation	Additional Transmission	Additional Distribution	Total Cost
Unmanaged Charging	2,345 MW	1 switching station 10 substations 18 transformers	2,158 km cables	\$4,586M
Off-Peak Incentives	1,770 MW	1 switching station 7 substations 13 transformers	1,581 km cables	\$3,414M
Managed Charging	<i>None</i>	<i>None</i>	287 km cables	\$471M

Source: Israel Electric Company study,. Table courtesy of Better Place.

Charging Infrastructure

- Level 2 charging (SAE 1772) will be the majority of charging both at home and in public and will be used by all OEMs for both electric and plug-in vehicles.
- DC Fast-charge (Level 3) is more expensive, but delivers higher performance.

Level	Input Voltage	Typical Charging Time	Breaker Size (A)	Electrical Loads (kW)	Typical Locations
I	120 V	8 – 12 hours	15-20	2	Standard 120 volt plug; NEV/Motorcycle charging, Emergency charging
II	240 V	2 – 4 hours	40 amp Typical	3-6	Residential garages, parking lots, public garages, transit centers
DC Quick Charge	480 V 3 phase	20 – 40 minutes	various	30-60	Rapid charging facility near high traffic volume arterials

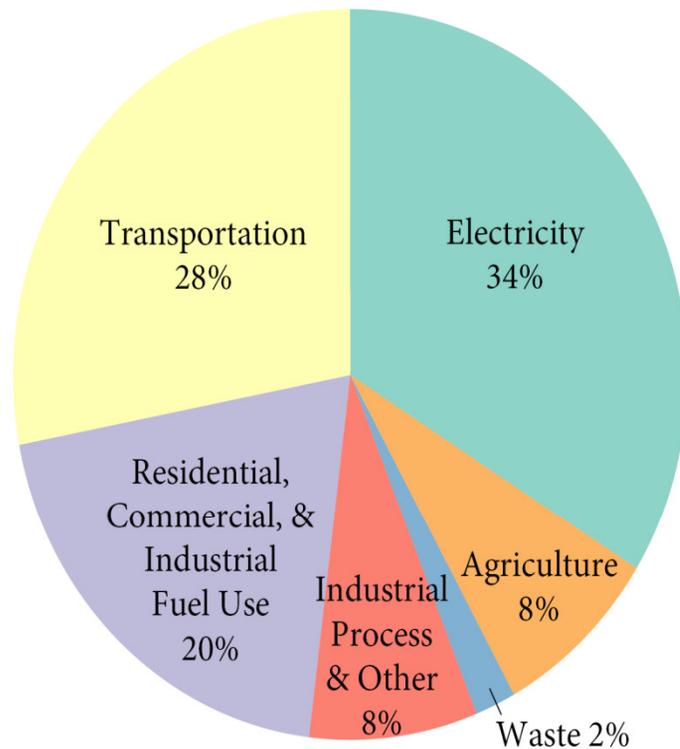
Charging Infrastructure

Level 1 and Level 2 Charging Equipment and Stations



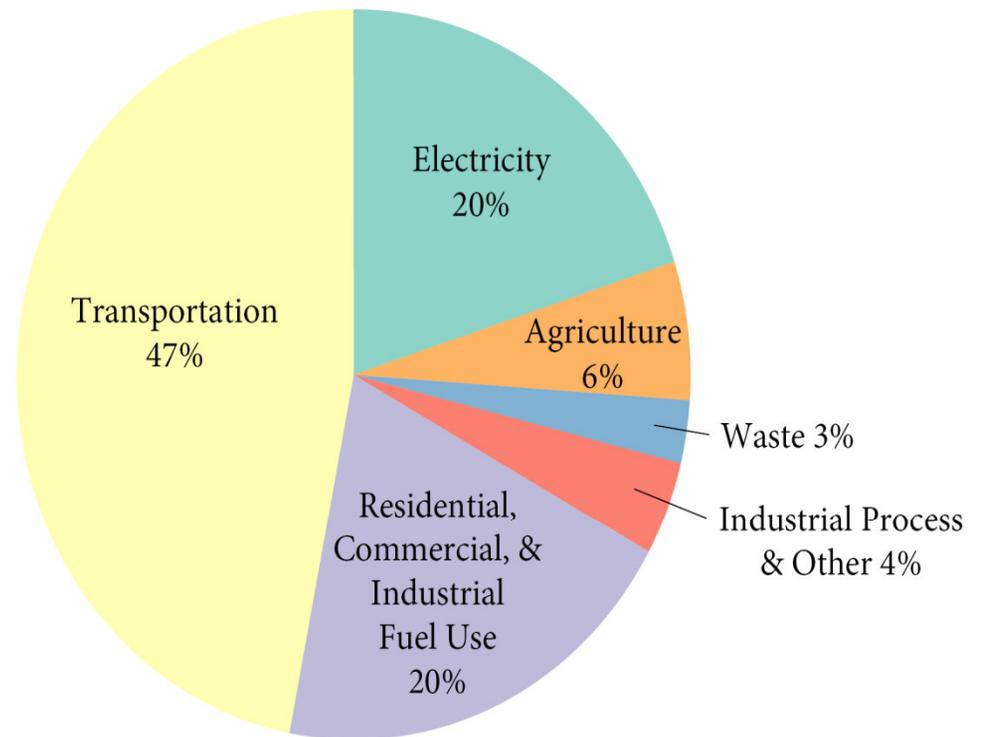
GHG emissions from Washington State's transportation sector (47%) are nearly double the national figures.

U.S. Greenhouse Gas Emissions



Source: Washington State Department of Ecology, 2005

Washington Greenhouse Gas Emissions



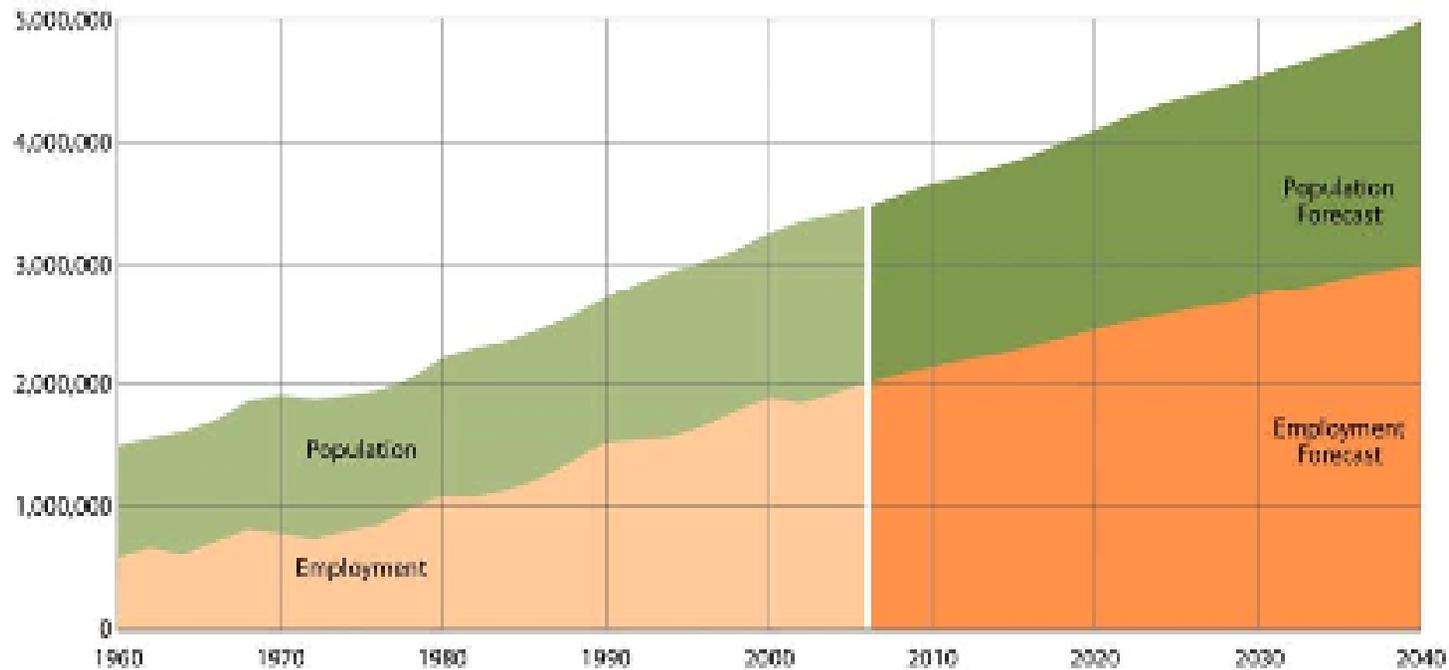
Source: Washington State Department of Ecology, 2005

IMPORTANCE TO STATE DOTs



Within the next 30 years, the central Puget Sound region is expected to grow by 1.5 million people – increasing travel demand by 40%.

Puget Sound region population and employment forecasts, 2040.



In spite of these ominous forecasts, Washington's transportation system must meet stringent state laws for GHG and VMT reduction.

GHG Reduction Targets:

- To 1990 levels by 2020
- To 25 percent below 1990 levels by 2035
- To 50 percent below 1990 levels by 2050

VMT Reduction Targets:*

- By 2020, decrease by 18%
- By 2035, decrease by 30%
- By 2050, decrease by 50%

*Statewide annual per capita VMT reductions, all fuel types.

West Coast Green Highway Initiative: public/private partnerships to promote sustainable transportation solutions in the I-5 corridor, “BC-to-Baja”



WEST COAST GREEN HIGHWAY

- Alternative Fuels Pilot Project
- **I-5 Electric Highway**
- NewMobility HUBs
- Solar and Wind Highway Facilities

“ This ‘green freeway’ you're planning...would link your states with a network of rest stops that allow you to do more than just grab a cup of coffee, but also charge your car.

- President Barack Obama
3/19/2009

WSDOT's I-5 Electric Highway



President Barack Obama

Goal: 1 million electric vehicles by 2015

Leveraging \$20 million federal investment in the Puget Sound region



- \$230 million total
 - \$115 million US DOE contract
- 8,300 Electric Vehicles
- 15,000 charging stations
- 16 metro areas in six states



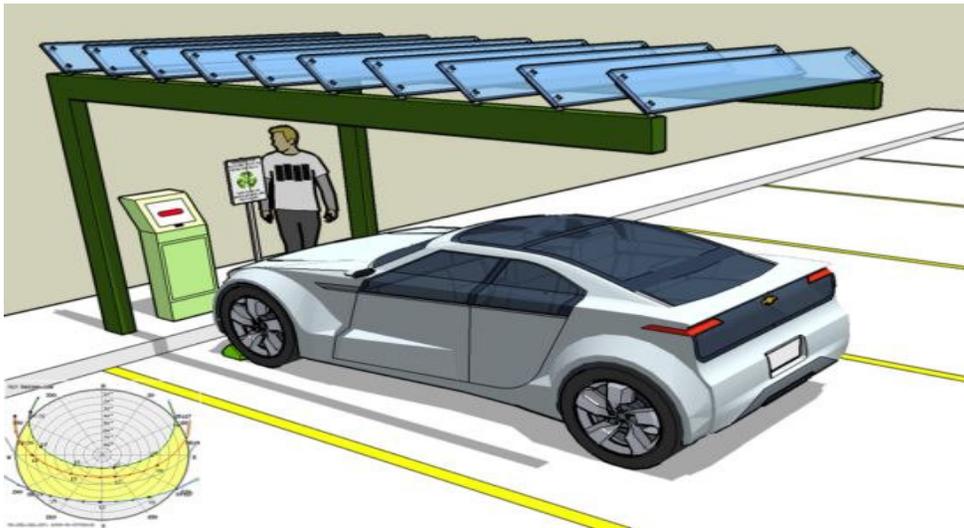
WSDOT's I-5 Electric Highway Project



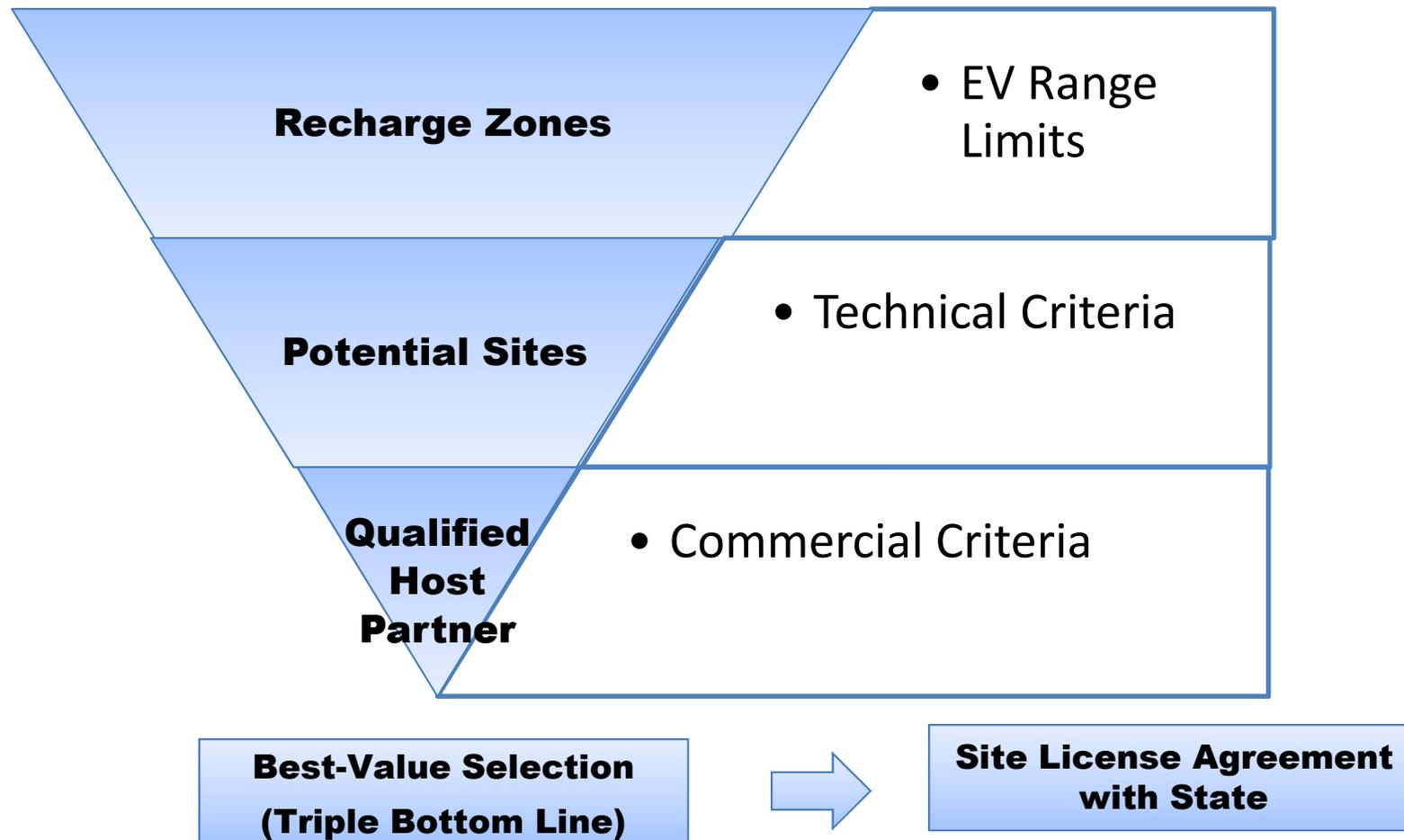
- Develop safety net of EV Fast-Charging stations throughout I-5 Corridor
- Seek partnerships with retail businesses located in critical recharge zones
- Coordinate EV infrastructure investments with other planned investments in Puget Sound Region
- Collaborate with Oregon and California on joint EV infrastructure development and funding

I-5 Electric Highway Partnership Approach

- Identifying Recharge Zones
- Finding Business Partners to Serve as Host Sites
- Selecting Contractor through Competitive Process



Screening and Site Selection Process



WSDOT's WEST COAST GREEN HIGHWAY INITIATIVE

Stage 1 Deployment: Critical Recharge Zones



- 2 Gateway Rest Areas (Level 2 charging for public education)
- 3 DC Fast Charge Sites (site selection and preparation)
- Detailed Analysis (lessons learned applied to Stage II full deployment)

Stage 2 Deployment: Corridor Completion



- Complete DC Fast-Charge network along I-5
- Additional recharge zones based on analysis of Stage 1
- Potential expansion east-west (I-90, SR 2)

Washington's Safety Rest Area "Gateway" Sites:



Visitor Information Booth – Gee Creek NB

Gee Creek Rest Area

- First point of entry from Oregon
- Located on I-5 Northbound (Vancouver area)
- 782,286 annual visitors



Custer Southbound Safety Rest Area

Custer Rest Area

- First point of entry from Canada
- Located on I-5 Southbound (Blaine area)
- 414,615 annual visitors

WSDOT's WEST COAST GREEN HIGHWAY



Showcasing emerging technologies and Washington-based companies and products



Real-time travel information



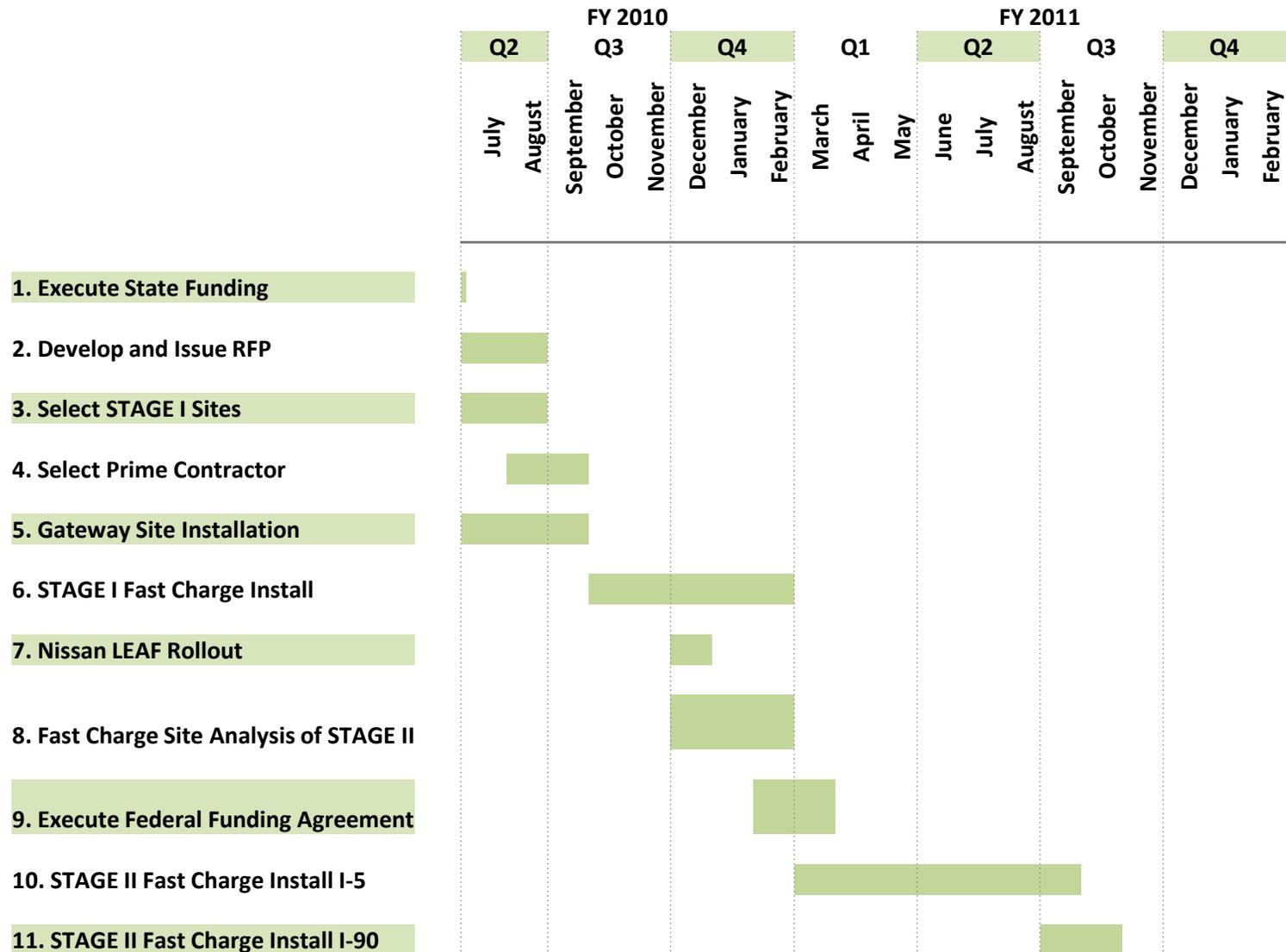
Renewable energy technologies



Consumer education: clean, smart transportation



I-5 Electric Highway Project Development Schedule



State and Local Government Assets:

- Under-utilized rights-of-way
- Park-and-Ride lots, transit centers
- Public office buildings with power supply
- Public parking stalls
- Public vehicle fleets
- Local signage (way-finder and location-based)
- Coordinated funding opportunities (grants, foundations, P3's)
- Leadership

Washington State DOT's I-5 Electric Highway Public/Private Partnership

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