Department of Environmental Quality

Low Carbon Fuel Advisory Committee
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Electricity as Transportation Fuel

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Electricity as Transportation Fuel

Overview:

1. Energy Economy Ratios
2. Electricity Used as Transportation Fuel
3. Electricity Used to Produce Other Fuel
4. Updating Carbon Intensities
5. Regulated Parties
6. Additional Electrification Activities

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1. Energy Economy Ratios

- **Electric Vehicles are far more efficient than conventional vehicles.**
- **Internal Combustion Engines (ICE) use almost 2/3rd of their energy to drive engine mechanical systems.**
- **Idling uses 17% of ICE energy (urban driving)**

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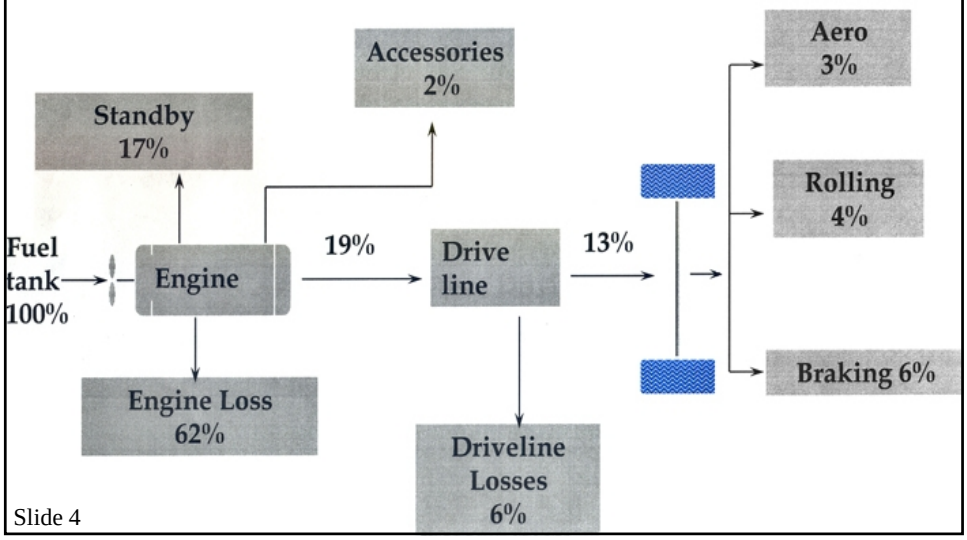
Where the energy goes

Urban Driving



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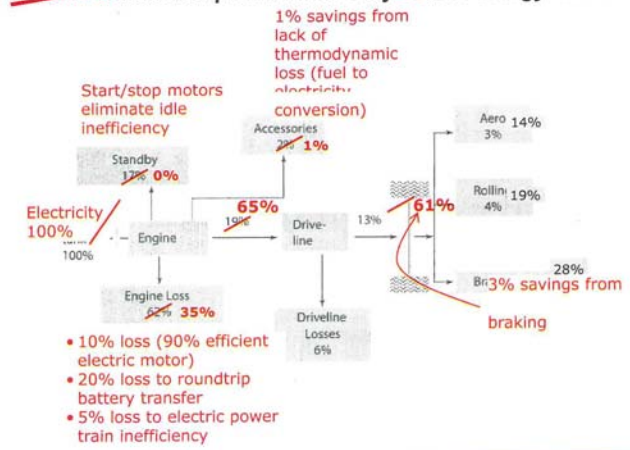
Power Train Comparison (Urban Driving)

Inefficiencies of Internal Combustion vs Electric

~~Internal combustion~~ Electric power train: only ~~13%~~ 61% of energy reaches tires



Sources: US Dept of Energy; Randy Reisinger of CalCars.org

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1. Energy Economy Ratios

CARB finds electric vehicles to be 4 times more efficient than current light duty fleet.

But, greenhouse gas emission requirements ("Pavley" rules) will improve efficiency of conventional vehicles 30% by 2016.

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1. Energy Economy Ratios

CARB's EER of 3 reflects the efficiency of EVs compared to the *future* conventional light duty fleet.

EVs that replace heavy duty drive trains have a slightly lower efficiency advantage.

CARB finds EVs that replace heavy duty vehicles have an EER of 2.7

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1. Energy Economy Ratios

DEQ Proposal: Use California's EERs for electric vehicles:

3 for electricity that replaces gasoline
2.7 for electricity that replaces diesel

Evaluate need for EER update in 2016 (with carbon intensity review)

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2. Carbon Intensity of Electricity Used as Transportation Fuel

LCFS rates fuels by their carbon intensity over their full life cycle (production, transport and use).

Carbon intensity is expressed as grams of carbon dioxide equivalent per Mega Joule (unit energy) or: g CO_2e/MJ

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2. Carbon Intensity of Electricity Used as Transportation Fuel

CI of electricity varies according to how it is generated.

High = Coal (343 g CO_2e/MJ)

Medium = Natural Gas (178 g CO_2e/MJ)

Low = Renewables & Nuclear (~0 g CO_2e/MJ)

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2. Carbon Intensity of Electric Utilities

PacifiCorp:	**262 g CO2e/MJ**
PGE:	**199 g CO2e/MJ**
Public Utilities:	**~10 g CO2e/MJ**
Statewide Av:	**155 g CO2e/MJ***

(Data represent 2007 as a proxy for 2010)

***Statewide average is weighted by the amount of power delivered**

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2. Carbon Intensity of Electric Utilities

After applying an EER of 3, CIs are:

PacifiCorp:	**87.3 g CO2e/MJ**
PGE:	**66.3 g CO2e/MJ**
Public Utilities:	**~3.3 g CO2e/MJ**
Statewide Av:	**51.7 g CO2e/MJ***

(For comparison, CI of Oregon's gas is ~ 92 g CO2e/MJ.)

***Weighted average**

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2. Carbon Intensity of Electricity Used as Transportation Fuel

What type of power is likely to serve as transportation fuel?

Current Power Mix,

- or -

New Resource Power?

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2. Carbon Intensity of Electricity Used as Transportation Fuel

"Current Power Mix" is the blend of electrical generation sources used to serve electrical demand within a utility's service district. Current Power includes base load power, peaking power, and market power. It does not include power generated for sale to others.

(DEQ definition for LCFS)

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2. Carbon Intensity of Electricity Used as Transportation Fuel

"New Resource Power" is new electrical generating capacity that serves increased long-term demand or replaces existing generation capacity.

(DEQ definition for LCFS)

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2. Electricity as Transportation Fuel

	Individual CIs	Est. of New Resources CI
PacifiCorp:	87.3 g CO2e/MJ	NA
PGE:	66.3 g CO2e/MJ	NA
Public Utilities	~3.3 g CO2e/MJ	NA
Statewide Av:	51.7 g CO2e/MJ	~59 g CO2e/MJ* (100% NG)

Actual Carbon Intensities reflect current mix of coal, hydro, natural gas, renew-ables, etc.

New Resource Carbon Intensity assumes future mix of natural gas with some renewables.

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2. Current Power vs. New Resource Power

Issues and Possible Consequences (verification of assumptions)

- Energy Conservation: Will conservation offset the growth of future electrical demand? What is likely to be the net effect?
- If New Resource Power: What is reasonable carbon intensity? Would one CI profile be common for all utilities?
- How should a LCFS factor in the effects of Renewable Portfolio Std.?
- Will New Resource Power be approximately the same for utilities in the future?

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2. Electricity as Transportation Fuel

Comments?

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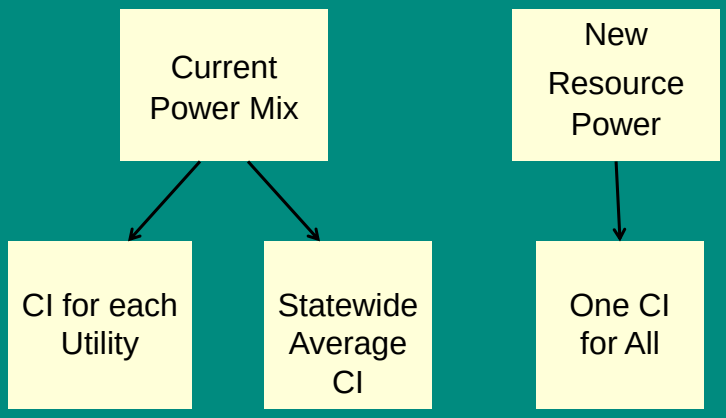
2. Carbon Intensity of Electricity Used as Transportation Fuel



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2. Current Power: Individual or Average?

	Individual CIs	Est. of New Resources CI
PacifiCorp:	87.3 g CO2e/MJ	NA
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Issues to Consider

Individual Carbon Intensities :

- **Would recognize actual differences between utilities.**
- **Could create geographic disparities in EV service according to high and low carbon intensity service areas.**

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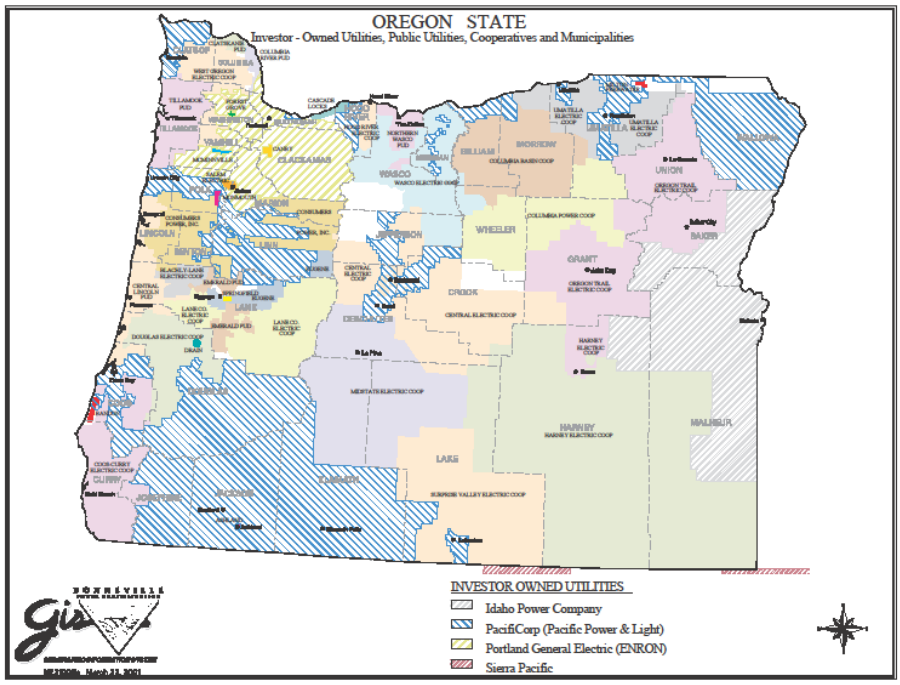

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2. Current Power: Individual or Average?

Issues to Consider

Average Carbon Intensity:

- **Would create a level playing field between utilities.**
- **Would treat different geographic areas equally.**
- **Would lose the link between vehicle charging and electricity CI.**
- **Would eliminate use of sub pathways for utilities with low CI.**

An average provides uniform treatment for all EV charging and LCF credit generation for all utilities and geographic areas. Therefore:

- **Keeps a LCFS neutral in affecting EV use and EV infrastructure.**
- **Would have a neutral effect on utilities wishing to opt-in and generate LCF credits.**
- **Is not accurate for each utility, but is accurate for the state overall.**

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2. Current Power: Individual or Average?

Issues to Consider

- **Should Oregon's LCFS program be neutral, and not indirectly influence other state program initiatives (for the better or worse), such as the goal for utilities to increase their use of low carbon electricity, or state initiatives to stimulate the use of electric vehicles? Design choices for the LCFS program may have some influence on other Oregon initiatives. Is that an acceptable outcome?**

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2. Current Power: Individual or Average?

Issues to Consider

How will the structure of electricity carbon intensity affect the generation of LCF credits?

- **Will participation be best with widely available credits of moderate value (average), or**
- **Would more credits be generated if only low CI utilities participate but with higher-value credits (individual approach)?**
- **Are opt-in decisions likely to be made independent of LCF credit potential?**
- **Will different LCF credit values affect the commercialization and development of charging infrastructure?**

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2. Transportation Electricity

At this point, DEQ favors using the estimated carbon intensity of "New Resource Power" as the default carbon intensity for electricity used as transportation fuel. On balance, DEQ believes this to be the best approach for the following reasons:

- NRP is likely to serve future demand,
- Will apply similarly to utilities, and
- NRP will lower the administrative burden utilities and DEQ

However, DEQ wishes to hear from the committee before deciding which approach to move forward with in our compliance scenarios and economic analysis.

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2. Transportation Electricity

Comments?

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3. Electricity Used to Make Other Fuels

Carbon intensity of electricity used in fuel production affects that fuel's final CI.

Same options as transportation fuel:

- **CI of current power, or CI of new resource power?**
- **If current power, use CI of individual utilities, or one statewide average?**

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3. Electricity Used to Make Other Fuels

One value for electricity CI (current power average or new resource power):

- **Less accurately reflects GHG emissions**
- **Provides geographic consistency**
- **Is easier to administer**
- **Will be more stable over time**

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3. Electricity Used to Make Other Fuels

Individual CIs for utilities:

- **More accurately reflect GHG emissions**
- **Allow geographic disparity**
- **Are more difficult to administer**
- **Are potentially more variable over time**

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3. Electricity Used to Make Other Fuels

An important difference between fuel production electricity and vehicle charging electricity:

Carbon intensities of fuels produced outside Oregon are based on statewide or regional averages.

DEQ must treat all fuel production facilities the same. Using individual CIs for all producers would be an extraordinary workload.

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3. Electricity Used to Make Other Fuels

DEQ proposes to use the statewide average carbon intensity of electricity used to produce fuels in Oregon.

(This approach is consistent with California.)

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4. Updating Electricity Carbon Intensity

Carbon intensity of electricity is likely to evolve

Good thing to have electricity CI adjust to actual changes, but…

Regulatory certainty is needed for regulated parties to plan their compliance strategies.

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4. Updating Electricity Carbon Intensity

California will review their LCFS in 2015.

DEQ proposes to evaluate electricity carbon intensities at program mid-point (2016).

Adjustments to electricity CI could be made as appropriate.

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5. Electricity Opt-In Parties

DEQ proposes participation of electricity (in LCFS program) to be voluntary.

California allows the following to opt in:

- Utilities (electricity providers)
- Bundled Service Providers
- Charging equipment owners (with utility approval)

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5. Electricity Opt-In Parties

Utilities (electricity providers)

Bundled Service Providers:

- **Charging *Subscription Services***
- **Examples are Coulomb and Better Place**

Charging equipment owners:

- **Requires agreement with utility**
- **Covers fleet owners and residential users**

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5. Electricity Opt-In Parties

DEQ proposes to use California's plan.
(Bundled Service providers have first choice.)

DEQ is open to different approaches:

- **Should more opt-in authority be given to charger owners?**
- **Other possibilities?**

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6. Other Electrifying Activities

There are additional ways electricity may substitute for gasoline or diesel.

- **Truckstop electrification (cost effective, increasingly available)**
- **Transport Refrigeration Units (diesel-powered refrigerated trailers etc. can switch to grid power if parked for long periods)**
- **Electric service equipment (ground equipment at airports electric forklifts, etc.**

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6. Other Electrifying Activities

More possibilities:

- **Shore power (docked ships use grid electricity rather than engine power), and**
- **Heating and cooling aircraft at boarding gates (equipment mounted at end of jetway can substitute for plane-mounted power units.**

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6. Other Electrifying Activities

Other applications are possible. Qualifying activities should:

Displace transportation fuel,
Not use exempt fuel
Not be already required.

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6. Other Electrifying Activities

DEQ will collect additional information on likelihood and feasibility of other qualifying activities.

Decisions not needed now.

Committee comments?

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