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Quantifying Criteria Emissions Reductions in CA from Efficiency and Renewables

Greenhouse Gas and Air Emissions Reductions through Energy & Peak Load Reductions and Renewable Generation

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Purpose

- Evaluate opportunities to reduce stationary source criteria emissions in California by employing energy efficiency (EE) and renewable energy (RE)
  - Displace fossil generators with EE and RE
  - Determine emissions reductions from displacement
  - Create tool for use by Air Districts to improve air quality through energy planning

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Regulatory Background

- In 2010/11, the EPA is expected to issue new ambient air quality standards for ozone and fine particulates. Air districts will be required to prepare new SIPs by 2014 to meet EPA standards.
- CA and other states will use EE, RE, and CHP measures (including AB32 & 33% RES) to meet in-state standards.
- EPA intends on updating guidance on using EE & RE to meet SIP requirements in 2010.
- Opportunities in CA:
  - Use AB32 and other energy saving measures to improve CA emissions;
  - Improve measurements and modeling of energy savings and emissions reductions to meet impending EPA criteria;
  - Provide methodology and training for estimating emissions reductions from EE and RE
  - Comprehensive multi-pollutant and energy planning

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Multi-Pollutant & Energy Planning

- Energy and environmental policies are inextricably linked
  - Stationary source emissions of GHG and toxics & water use
- Historically, emissions policies were met with end-of-pipe controls
  - Unintended consequences: increase GHG, toxic pollutants, and water consumption
  - Prolong life of low-efficiency generators by with incremental capital additions
  - Cost-effective controls already implemented: How do we reach more aggressive emissions targets?
- Policies to reduce criteria, toxic, and GHG pollutants 10-15 years in the future:
  - Examine cost effective, comprehensive planning solutions
  - Efficiency (EE), renewable energy (RE), and improved combined heat and power (CHP) can meet electrical requirements without increasing emissions
- For example, the Bay Area AQMD Board approved first multi-pollutant plan in the US on 9/15/10.
  - EPA working now with NY, NC, MD, St Louis to help inform guidance for air districts complete multi-pollutant air plans for 2013-14.

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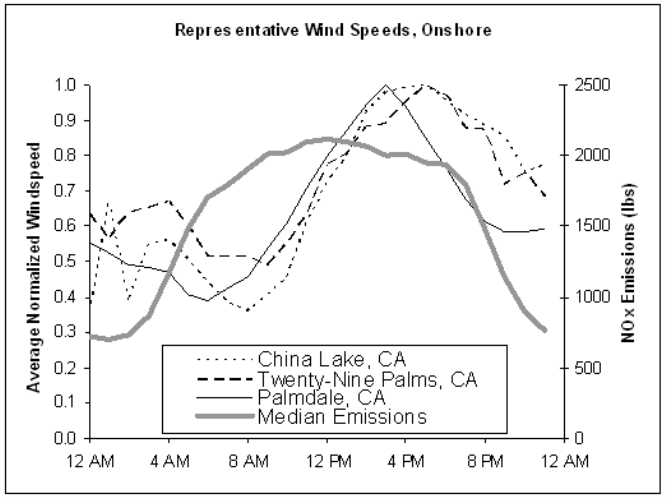
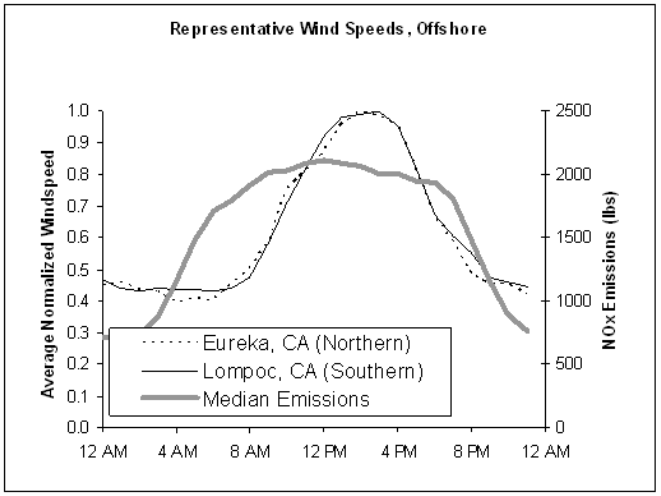
Background

- Phase I (Completed June, 2009)
  - Regulatory opportunities to use energy reduction measures for SIP credit
  - Examined coincidence of specific EE and RE programs with peak pollution
  - Reviewed appropriate models for estimating emissions reductions
  - Reviewed other state EE and RE emissions reduction calculations for potential SIP credit





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Background

- Phase II (2011)
  - Provide tool for air districts to determine air quality benefits of specific EE and RE programs
  - Model current and future electrical system in CA
  - Model variety of EE and RE programs, determine which generators are displaced and degree to which emissions are impacted

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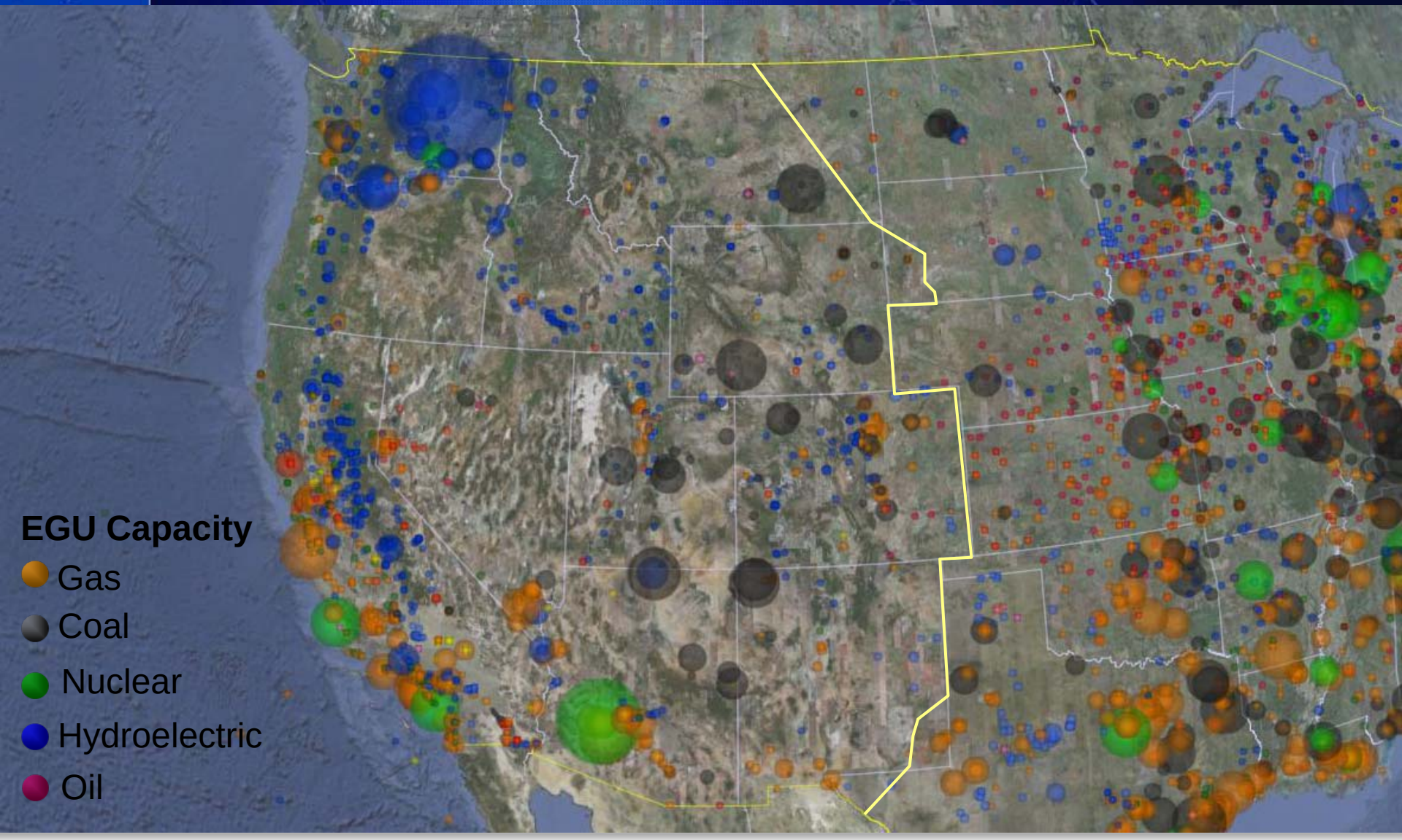
CA and the Western Interconnection



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Displaced Emissions

- Adding in incremental EE and RE displaces *existing* resources in the near term, and the need for *new* resources in the future
  - In the near-term, we would hypothesize that the most expensive dispatchable resource (gas) would be displaced
    - May be inefficient [dirty], high cost gas (or oil) energy *or* efficient [clean] out-of-state gas with high transmission cost
    - Unlikely to be out-of-state coal: inexpensive, and not on the margin in WECC, except in some trough hours
- Project seeks:
  - Which resources are displaced
  - In state or out-of-state
  - Benefits to criteria emissions in CA, which air districts
  - Carbon reductions & where accrued

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Air Benefits Planning Tool

- Model CA energy to 2020 along both 20% and 33% RE pathways
  - Using electric system dispatch model (Market Analytics from Ventyx), assumptions and database from the CEC
  - Determine which generators (current and future) are displaced by RE and EE
- Map emissions benefits to air districts
  - Look at incremental EE and RE programs, and subsequent benefits to air districts
- Provide planning tool to districts
  - Emissions benefits from specific programs (i.e. onshore & offshore wind, PV, solar thermal, baseload EE reductions, peak load reductions)
  - Interdisciplinary opportunity

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Current Steps

- Mapping model generation and emissions to specific generators and locations
- Rectifying stationary source emissions estimates from model to available measured data
- Modeling 20% and 33% RES trajectories and subsequent displaced emissions
- Preparing data for incremental EE and RE study

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Emissions in CA in 2012 according to Ventyx Model: Generation, CO_2, NO_X and SO_2

	Generation (GWh)	Fraction of Generation	Fraction of CO2	Fraction of Nox	Fraction of SO2
EGU - Report to EPA	54,273	25.0%	44.9%	5.5%	1.6%
Cogeneration	24,798	11.4%	30.3%	59.5%	69.9%
Biomass	6,494	3.0%	8.0%	20.9%	0.1%
Future Generation	14,809	6.8%	11.5%	8.4%	0.3%
Non-Emitting Resources	113,365	52.2%	0.0%	0.0%	0.0%
Small EGU and Boiler	3,438	1.6%	5.2%	5.6%	28.1%
Ventyx 2012 Total	217,178	Emissions (Tons)	58,136 -	41.4 -	8.1 -
eGRID 2005 Total	199,924		52,763 -	22.3 -	13.6 -

Non-emitting resources include hydro, pumped storage, wind, solar, PV, nuclear, and geothermal.

**Fraction of emissions (CO2, NOx and SO2) from Ventyx output, before rectification*

*** Emissions from Ventyx are known to be inaccurate for units which do not report to the EPA. We are currently correcting these, primarily in a downward direction.*

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Conclusions

- According to model results, cogeneration is responsible for a disproportionate fraction of stationary source emissions
  - Mostly refinery operations
  - Emissions estimates from model do not rectify with federal estimates – but even corrected, still high emissions
  - Would co-gen operations be displaced by EE or RE? Appears that some sell electricity to CA utilities: how should these units be treated?
- Biomass facilities can qualify to help meet California RPS.
  - Based on the criteria pollutant emissions, how could air and energy regulators work together to assure that biomass resources can meet both air and RPS requirements?
- Table represents state-wide emissions, not displaceable emissions in particular zones
  - Likely to be differences in specific load zones
  - In electrically congested areas such as LA, EE/RE/CHP might displace local emissions
  - In some regions, EE/RE/CHP may displace distant, or even out-of-state emissions

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Questions

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Emissions Sources in CA according to Ventyx Model: CO_2, NO_X and SO_2

	Generation (GWh)	Fraction of Generation	CO2 (tons)	CO2 Rate (lbs/Mwh)	Fraction of CO2
EGU - Report to EPA	54,273	25.0%	26,117,980	962.5	44.9%
Cogeneration	24,798	11.4%	17,636,708	1,422.4	30.3%
Biomass	6,494	3.0%	4,674,180	1,439.6	8.0%
Future Generation	14,809	6.8%	6,703,708	905.3	11.5%
Non-Emitting Resources	113,365	52.2%	0	0	0.0%
Small EGU and Boiler	3,438	1.6%	3,004,068	1,747.7	5.2%
Ventyx 2012 Total	217,178	-	58,136,645	-	-
eGRID 2005 Total	199,924	-	52,763,000	-	-

Non-emitting resources include hydro, pumped storage, wind, solar, PV, nuclear, and geothermal.

	Nox (Tons)	Nox rate (lbs/Mwh)	Fraction of Nox	SO2 (Tons)	SO2 rate (lbs/Mwh)	Fraction of SO2
EGU - Report to EPA	2,284	0.08	5.5%	126	0.005	1.6%
Cogeneration	24,697	1.99	59.5%	5,643	0.455	69.9%
Biomass	8,687	2.68	20.9%	10	0.003	0.1%
Future Generation	3,489	0.47	8.4%	25	0.003	0.3%
Non-Emitting Resources	0	0.00	0.0%	0	0.000	0.0%
Small EGU and Boiler	2,316	1.35	5.6%	2,271	1.321	28.1%
Ventyx 2012 Total	41,474	-	-	8,076	-	-
eGRID 2005 Total	22,302	-	-	13,576	-	-

Non-emitting resources include hydro, pumped storage, wind, solar, PV, nuclear, and geothermal.

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