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Center for Clean Air Policy

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To Jim Boyd and Susan Brown, California Energy Commission

From Stacey Davis and Ned Helme, Center for Clean Air Policy

RE Summary of GHG Mitigation Measures Evaluated by CCAP and ICF Consulting

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To inform the deliberations of the California Energy Commission's Climate Change Advisory Committee and to assist the Energy Commission in its development of recommendations in the Integrated Energy Policy Report, the Center for Clean Air Policy (CCAP or the Center) conducted and compiled "bottom-up" assessments of measures that can reduce greenhouse gas emissions in California. Where available, we used existing California analyses and supplemented this work, where needed, with our own independent analysis.

The goal of this effort was to identify and quantify a range of greenhouse gas emissions reduction and sequestration opportunities in the state, including the total emissions reductions and sequestration that might reasonably be achieved and the potential costs of these reductions. We also considered policy options that might be used to encourage implementation.

Specifically, the Center for Clean Air Policy evaluated the cost-effectiveness and reduction potential for greenhouse gas (GHG) mitigation options in the transportation and cement sectors, as well as options for sequestering carbon dioxide emissions in the forestry and agriculture sectors. This work was combined with a series of sector-specific GHG mitigation analyses conducted by ICF Consulting for the Energy Commission's PIER program. ICF consulting evaluated measures to reduce high global warming potential gases in the landfill, natural gas, semiconductor and dairy sectors, among others.

Summary of Results

In total, the measures analyzed by CCAP and ICF are projected to reduce GHG emissions by 44 $MMTCO_2e$ in 2010 and 117 $MMTCO_2e$ in 2020 (Table 1).

Table 1. Total GHG Reduction Potential ($MMTCO_2e$)

Sector	2010 CCAP/ICF	2020 CCAP/ICF
Transportation	8.3	65.4
Power	TBD	TBD
Agriculture/Forestry	12.5	18.0
Methane	15.6	16.7
PFC	3.1	7.1
HFC	0.9	6.2
Cement	2.2	2.4
SF6	1.2	1.5
Oil Refining	TBD	TBD
ALL	43.8	117.4

Importantly, the measures evaluated by CCAP and ICF are additional to a set of strategies already underway in California that were compiled by state agencies in support of Governor Schwarzenegger's June 1, 2005 climate change announcement. Such strategies are estimated to reduce GHG emissions in the state by 23 MMTCO2e in 2010 and 70 MMTCO2e in 2020.

Table 2. Strategies Already Underway in California.

Lead Agency/Strategy	GHG Savings[1] (Million Tons CO_2 Equivalent) 2010	2020
[illegible]		
GHG Vehicle Standards (AB 1493)	1	30
Diesel Anti-idling	1	2
[illegible]		
Accelerated Renewable Portfolio Std (33% by 2020)	5	11
Million Solar Roofs	0.4	3
[illegible]		
Zero Waste/High Recycling Programs	7	10
[illegible]		
Full cost-effective natural gas efficiency improvements	1	6
Appliance Efficiency Standards[2]	3	5
Fuel-efficient Replacement Tires & Inflation Programs	3	3
[illegible]		
Reduced Venting and Leaks in Oil and Gas Systems	1	1
[illegible]		
Green Buildings Initiative	Not yet estimated	
[illegible]		
Hydrogen Vehicles	Not yet estimated	
Total Potential Emission Reductions[3]	23	70

Also, we have not yet conducted "bottom up" analyses of the power and oil refining sectors. These sectors contribute significantly to the state inventory[1] and have the potential to contribute significant emissions reductions. If reductions from these sectors were achieved equivalent to 2000 levels in 2010 and 2020 for the power sector, and 2005 levels in 2010 and 2020 for the refining sector, total reductions from these sectors would come to 17 $MMTCO_2e$ in 2010 and 32 $MMTCO_2e$ in 2020. Additional analysis is needed to determine the technical viability and cost of such emissions reductions.

Table 3. Comparison with Alternative Targets

	2010	2020
CEC estimated baseline emissions (very preliminary)* with adjustments** in 2020	538	575-590
2000 emissions (gross CA emissions w/imported electricity)	489	489
difference	49	86-101
1990 emissions (gross CA emissions w/imported electricity)	439	439
difference	98	136-151
CCAP/ICF measures	44	117
Strategies already underway in CA	23	70
Total mitigation measures	67	187
Hypothical additional reductions from power/refining (stabilize at 2000/current levels)	17	32

In all, based on a very preliminary baseline emissions estimate developed by CEC[2] with some adjustments by CCAP in the 2020 period to reflect growth in emissions from sectors beyond increases in gasoline demand, there appear to be sufficient emissions reduction opportunities available in the state to meet aggressive GHG reduction targets such as those established by Governor Schwarzenegger (Table 3). Moreover, it appears that if the most cost-effective control measures were used, it would be possible to achieve the 2010 GHG reduction target at a cost of less than $20 per metric ton of carbon dioxide equivalent ($MTCO_2e$). Based on the measures and sectors evaluated, however, the marginal costs of reducing CO_2 emissions would be significantly higher in the 2020 timeframe. (Table 4)

[1] According to the most recent state inventory, in-state power plants emitted about 44 $MMTCO_2e$ in 2002 and imported power accounted for about 52 MMTCO2e in 2002. A CCAP analysis estimates that refineries emit 35 $MMTCO_2e$ in 2005.

[2] Preliminary projections for 2010 and 2020 are based on estimates by Gerry Bemis and Jennifer Allen published in Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2002 Update, June 2005. The 2020 estimates were increased by CCAP staff to reflect potential growth in other sectors beyond increases in gasoline demand. These projections should be considered placeholders until final state estimates are developed.

Table 4. Summary of Cost-Effectiveness of Measures Identified ($/MTCO$_2$e)

Cumulative GHG reductions from CCAP/ICF measures at each cost step, all sectors (approximate)		
	Reductions (MMTCO2e)	
Step	2010	2020
<0	7	10
<$10	22	25
<$20	27	31
<$30	29	38
<$50	33	75

We found that significant cost-effective mitigation actions are available in the dairy, landfill, agriculture and forestry, and cement sectors. The charts below summarize by cost the relative contributions that could be achieved from the different sectors evaluated. (Charts 1 & 2)

Chart 1: Emissions Reductions in 2010 by Sector and Cost (<$50/MMTCO$_2$e)

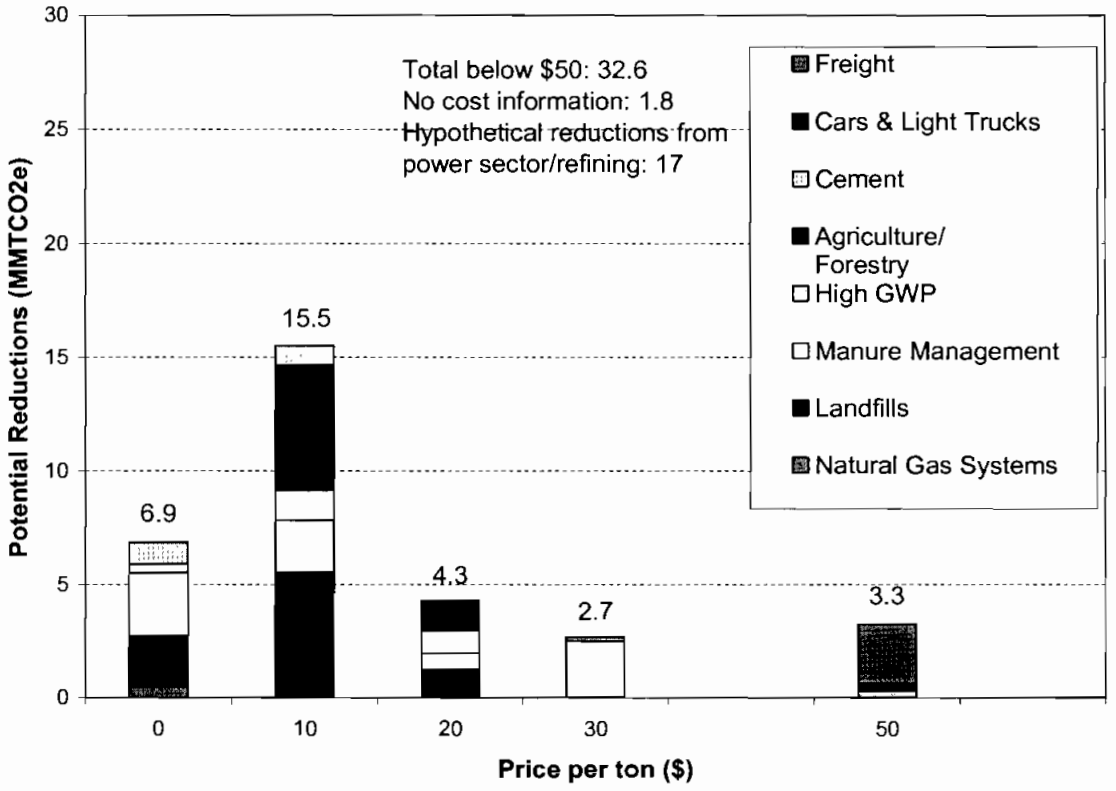
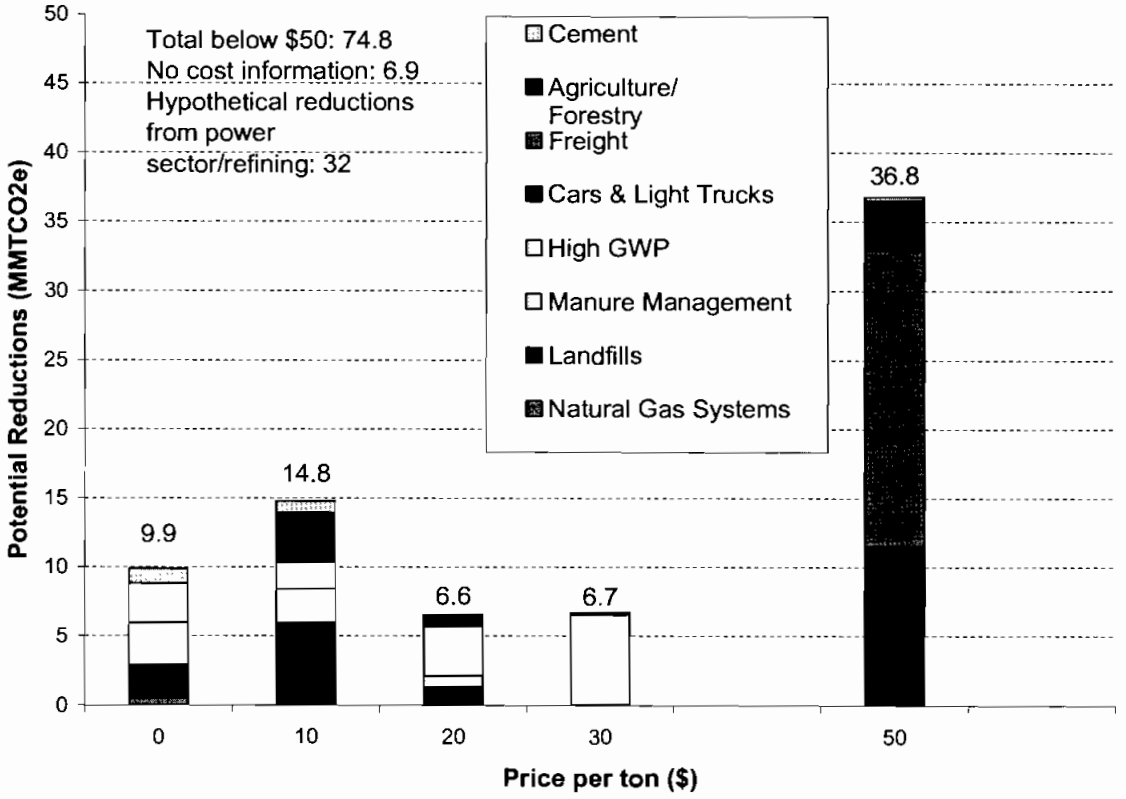


Chart 2: Emissions Reductions in 2020 by Sector and Cost (<$50/MMTCO$_2$e)



Importantly, while some of the measures do not appear cost-effective when evaluated just for their greenhouse gas emissions benefits, they may be cost-competitive when considering co-benefits. For example, many transportation measures will reduce criteria pollutants in addition to emissions of greenhouse gases. In nonattainment areas, these pollutants have a market value that would defray the overall cost of the control measure. Other co-benefits may be less quantifiable, such as improvements in livability from measures that reduce sprawl.

On the other hand, some of the measures that are determined to be the most cost-effective may be politically difficult to achieve. For example, while forestry measures such as thinning for forest health, afforestation, and converting from hardwoods to conifers offer over 10 MMTCO$_2$e of reductions at roughly $10 per ton, achieving this level of reductions would likely require implementation of a mandatory control program applicable to large landowners. However, some feel that existing rigorous forest practice rules in the state, coupled with global competition, aging demographics and increasing population, among other things, is already causing high levels of forestland turnover and forestland conversion in California. Additional mandatory controls could exacerbate this trend and would likely be resisted by the forest industry and by forest advocates.

In addition, some of the measures may not include the full costs. In particular, ICF's analysis of emissions reductions in the dairy industry may not include the full costs of NO_x control technologies that would be needed to meet more stringent air quality requirements in the San Juaquin Valley. Moreover, ICF's most recent assessment of methane reduction opportunities in

the landfill sector has changed significantly from their earlier version with use of a different methodology. These numbers may be more uncertain than cost estimates for other sectors.

Finally, as noted earlier, there may be additional cost-effective opportunities in the power and refining sectors, as well as cost-effective control options available to other sectors not included in these analyses. For example, direct combustion emissions from the commercial and residential sectors were not evaluated and could play an important role in mitigating greenhouse gas emissions in California.