

North Carolina

Climate Action Plan Advisory Group

Energy Supply
Technical Work Group
Teleconference Meeting #11

April 19, 2007



Today's Agenda

- Call to order
- Roll Call of TWG members and public
- Review and approval of summary of TWG call #10 (March 22, 2007) (on website)
- Review results of updated analyses (ES-1, ES-2, ES-4, ES-5, ES-6, ES-7, ES-8, and ES-10) and identify/resolve all outstanding issues/questions
- Call to the public, announcements
- Proposed agenda items and date/times for next meeting
- Announcements

Review of CAPAG Instructions to the ES TWG

- ES-1: returned to ES TWG for further review
- ES-2: returned to ES TWG for further review
- **ES-3 & ES-9: analysis accepted; no action required**
- ES-4: no further analysis requested
- ES-5: returned to ES TWG for further review
- ES-6: returned to ES TWG for further review
- ES-7: returned to ES TWG for further review
- ES-8: returned to ES TWG for further review
- ES-10: returned to ES TWG for further review

Further Review Consists of the Following Analyses

- Rate impacts of each mitigation option
- Range of cost assumptions for renewable energy (ES TWG; Low LaCapra; High LaCapra)
- Range of renewable mix (practical LaCapra; technical LaCapra; EIA average)
- Range of efficiency/renewable targets (original target, combined 20% target; demand growth offset combined target)
- Solar PV set-asides by 2020 (1%, 2%, 3%)

Method for Calculating Rate Impacts

- Determine displacement of fossil generation by energy efficiency renewable generation
- Determine incremental cost associated with this displacement.
- Calculate rate impact by dividing the annual cost impact by total resulting retail electricity sales in NC

Cost Assumptions for Renewable Energy Technologies (\$/MWh)

Renewable Resource	ES TWG	LaCapra	
		Low	High
hydro	128	108	130
wind	55	55	105
solar PV	189	186	325
hog waste	54	73	73
poultry litter	28	73	73
biomass cofiring in coal plants	3	5	20
dedicated biomass combustion	66	83	115

Renewable Energy Mix by 2020

Renewable Resource	LaCapra		EIA
	Practical	Maximum	
hydro	11%	3%	0%
wind	25%	40%	81%
solar PV	0%	0%	0%
hog waste	4%	1%	0
poultry litter	5%	2%	0
biomass cofiring in coal plants	16%	20%	0
dedicated biomass combustion	16%	20%	19%

Efficiency & Renewable Energy Targets by 2020

Target	Percent of Sales (%)			Total Savings/Generation (GWh)		
	Energy efficiency	Renewable Energy	Total	Energy efficiency	Renewable Energy	Total
Original	20%	11%	31%	32,165	18,644	50,810
20% combined	13%	7%	20%	20,601	11,941	32,543
Load growth offset	12%	7%	19%	19,652	11,391	31,043

Solar PV set-asides by 2020 (relative to penetration scenario)

Sensitivity	LaCapra		EIA
	Practical	Maximum	
PV set aside #1	0%	0%	0%
PV set aside #2	1%	1%	1%
PV set aside #3	2%	2%	2%
PV set aside #4	3%	3%	3%

Modeling Framework – Sensitivity Analyses

- **ES-1:** 27 sensitivity analyses
- **ES-2:** 71 sensitivity analyses
- **ES-4:** 8 sensitivity analyses
- **ES-5:** NA
- **ES-6:** 8 sensitivity analyses
- **ES-7:** NA
- **ES-8:** NA
- **ES-10:** 27 sensitivity analyses

Sensitivity Analysis – Simplified Approach

- Modeling framework set up to run all 173 sensitivity analyses.
- For presentation today, assumed the following defaults:
 - LaCapra practical renewable energy mix
 - 2% PV set aside by 2020
- Total sensitivity results presented (41):
 - ES-1: 5 results
 - ES-2: 15 results
 - ES-4: 8 results
 - ES-5: NA
 - ES-6: 8 results
 - ES-7: NA
 - ES-8: NA
 - ES-10: 5 results

ES-1: Renewable Energy Incentives - Approach Adopted at TWG #10

- **Long-term costs:** provide details on the present value results (2008-2020) for each technology option
- **Benefits:** include a qualitative description about the ancillary benefits (environmental, market) of the incentives
- **Rate impacts:** include an assessment of the rate impacts from this mitigation option

ES-1: RE Incentives - Overall Results

Option #	Option Name	GHG Reductions (E6 tonnes CO2-equiv)			NPV of Costs (E6 2005\$)	Cost of Saved Carbon	2020 Rate impact (2005 cents/kWh)		
		2010	2020	Total (2007-2020)			Energy efficiency	Renewable energy	Total
ES-1	Incentives for centralized renewables								
1	Original analysis (default assumptions)	0.03	0.11	0.97	\$33	\$34.2		0.0001	0.0001
2	Original analysis - low levelized cost estimate	0.02	0.08	0.66	\$57	\$86.3		0.0001	0.0001
3	Original analysis - high levelized cost estimate	0.01	0.03	0.23	\$91	\$404.4		0.0001	0.0001
4	Original analysis - CCS levelized cost estimate (2% solar PV set-aside)	0.03	0.11	0.96	\$33	\$34.9		0.0001	0.0001
5	Original analysis - low levelized cost estimate (2% solar PV set-aside)	0.02	0.07	0.65	\$57	\$87.1		0.0001	0.0001
6	Original analysis - high levelized cost estimate (2% solar PV set-aside)	0.01	0.03	0.22	\$90	\$406.6		0.0001	0.0001

ES-1: RE Incentives - Detailed Results (ES TWG costs)

Resource	Net costs (E6 2005\$) - Cumulative - after incentives	NPV of Costs (E6 2005\$)	Cost of Saved Carbon (2005\$/tCO2 avoided)
Hydro	\$1	\$3	\$249.8
wind	\$0	\$0	-\$5.0
solar PV	\$0	\$0	\$0.0
biomass and waste	\$12	\$31	\$34.1
hog waste	\$0	\$0	-\$8.0
poultry litter	-\$1	-\$3	-\$101.6
biomass cofiring in coal plants	\$12	\$30	\$39.1
dedicated biomass combustion	\$1	\$3	\$35.4
Total	\$13	\$33	\$34.2

ES-2: EPS - Approach Adopted at TWG #10

- 1) Evaluate original targets with various sensitivities
- 2) Evaluate 20% target for energy efficiency and renewable energy, combined (solar set asides)
- 3) Evaluate load growth target for energy efficiency and renewable energy, combined (solar set asides)

ES-2: EPS - Overall Results (original analysis with sensitivities)

Option #	Option Name	GHG Reductions (E6 tonnes CO2-equiv)			NPV of Costs (E6 2005\$)	Cost of Saved Carbon	2020 Rate impact (2005 cents/kWh)		
		2010	2020	Total (2007-2020)			Energy efficiency	Renewable energy	Total
ES-2a	EPS - original targets								
1	Original analysis (default assumptions)	6.77	43.43	280.68	\$981	\$3.5	0.049	0.088	0.1373
2	Original analysis - low levelized cost estimate	6.77	43.43	280.68	\$2,216	\$7.9	0.049	0.103	0.1519
3	Original analysis - high levelized cost estimate	6.77	43.43	280.68	\$7,384	\$26.3	0.049	0.178	0.2267
4	Original analysis - CCS levelized cost estimate (2% solar PV set-aside)	6.77	43.43	280.68	\$1,139	\$4.1	0.049	0.092	0.1410
5	Original analysis - low levelized cost estimate (2% solar PV set-aside)	6.77	43.43	280.68	\$2,314	\$8.2	0.049	0.106	0.1552
6	Original analysis - high levelized cost estimate (2% solar PV set-aside)	6.77	43.43	280.68	\$7,540	\$26.9	0.049	0.184	0.2325

ES-2: EPS - Overall Results (20% combined target with sensitivities)

Option #	Option Name	GHG Reductions (E6 tonnes CO2-equiv)			NPV of Costs (E6 2005\$)	Cost of Saved Carbon	2020 Rate impact (2005 cents/kWh)		
		2010	2020	Total (2007-2020)			Energy efficiency	Renewable energy	Total
ES-2b	EPS - 20% combined target by 2020								
1	20% target analysis (default assumptions)	5.90	23.37	166.22	(\$1,837)	(\$11.1)	0.028	0.051	0.0798
2	20% target analysis - low levelized cost estimate	5.90	23.37	166.22	(\$999)	(\$6.0)	0.028	0.060	0.0883
3	20% target analysis - high levelized cost estimate	5.90	23.37	166.22	\$2,517	\$15.1	0.028	0.103	0.1318
4	20% target analysis - CCS levelized cost estimate (2% solar PV set-aside)	5.90	23.37	166.22	(\$1,723)	(\$10.4)	0.028	0.054	0.0819
5	20% target analysis - low levelized cost estimate (2% solar PV set-aside)	5.90	23.37	166.22	(\$926)	(\$5.6)	0.028	0.062	0.0902
6	20% target analysis - high levelized cost estimate (2% solar PV set-aside)	5.90	23.37	166.22	\$2,628	\$15.8	0.028	0.107	0.1352

ES-2: EPS - Overall Results (load offset target with sensitivities)

Option #	Option Name	GHG Reductions (E6 tonnes CO2-equiv)			NPV of Costs (E6 2005\$)	Cost of Saved Carbon	2020 Rate impact (2005 cents/kWh)		
		2010	2020	Total (2007-2020)			Energy efficiency	Renewable energy	Total
ES-2c	EPS - combined target offsetting demand growth								
1	demand growth offset analysis (default assumptions)	5.53	22.29	160.27	(\$1,771)	(\$11.0)	0.025	0.046	0.0714
2	demand growth offset analysis - low levelized cost estimate	5.53	22.29	160.27	(\$963)	(\$6.0)	0.025	0.054	0.0790
3	demand growth offset analysis - high levelized cost estimate	5.53	22.29	160.27	\$2,427	\$15.1	0.025	0.093	0.1182
4	demand growth offset analysis - CCS levelized cost estimate (2% solar PV	5.53	22.29	160.27	(\$1,661)	(\$10.4)	0.025	0.048	0.0733
5	demand growth offset analysis - low levelized cost estimate (2% solar PV	5.53	22.29	160.27	(\$893)	(\$5.6)	0.025	0.056	0.0808
6	demand growth offset analysis - high levelized cost estimate (2% solar PV	5.53	22.29	160.27	\$2,534	\$15.8	0.025	0.096	0.1213

ES-3&9: CHP

- Not applicable (these options have already been recommended to the Commission based on the analysis completed by the ES TWG thus far.

ES-4: Cap and Trade - Approach Adopted at TWG #10

- It would be good for the ES TWG to make a clear recommendation to the CAPAG relative to a state versus a national cap and trade option.

ES-4: Cap & Trade - Overall Results (electric sector)

Option #	Option Name	GHG Reductions (E6 tonnes CO2-equiv)			NPV of Costs (E6 2005\$)	Cost of Saved Carbon	2020 Rate impact (2005 cents/kWh)		
		2010	2020	Total (2007-2020)			Energy efficiency	Renewable energy	Total
ES-4	Cap GHG and trade - electric sector only								
	safety valve price trajectory #1	0.85	3.66	22.18	\$129	\$5.83			0.0044
	safety valve price trajectory #2	0.74	5.39	28.82	\$238	\$8.27			0.0098
	safety valve price trajectory #3	2.58	17.05	90.02	\$1,850	\$20.55			0.0676
	safety valve price trajectory #4	3.49	26.61	144.19	\$4,213	\$29.22			0.1340

ES-4: Cap & Trade - Overall Results (economywide)

Option #	Option Name	GHG Reductions (E6 tonnes CO2-equiv)			NPV of Costs (E6 2005\$)	Cost of Saved Carbon	2020 Rate impact (2005 cents/kWh)		
		2010	2020	Total (2007-2020)			Energy efficiency	Renewable energy	Total
ES-4	Cap GHG and trade - economywide								
	safety valve price trajectory #1	1.85	7.41	49.30	\$294	\$5.96			0.0040
	safety valve price trajectory #2	1.95	10.68	65.65	\$556	\$8.46			0.0089
	safety valve price trajectory #3	4.34	24.04	138.56	\$2,881	\$20.79			0.0663
	safety valve price trajectory #4	5.34	33.26	189.09	\$5,546	\$29.33			0.1375

ES-5: Legislative Changes to Address Environmental & Other Factors - Approach Adopted at TWG #10

- No further analysis needed - make a recommendation based on Option #2 in the 15 January 2007 memo to the ES TWG (on website)

ES-6: IGCC with carbon capture and storage - Approach Adopted at TWG #10

- Replace 800 MW of **existing** coal-fired capacity in NC with an IGCC
- Replace 800 MW of projected **new** coal-fired capacity in NC with an IGCC
- Provide a comparison of the costs and benefits of the two sensitivities

ES-6: IGCC with carbon capture and storage - Overall Results (displace new coal)

Option #	Option Name	GHG Reductions (E6 tonnes CO2-equiv)			NPV of Costs (E6 2005\$)	Cost of Saved Carbon	2020 Rate impact (2005 cents/kWh)		
		2010	2020	Total (2007-2020)			Energy efficiency	Renewable energy	Total
ES-6a	IGCC with/without carbon capture and storage - replace new 800 MW plant								
1	With carbon capture & - central cost estimates	0.00	3.88	31.04	\$781	\$25.2			0.0007
2	IGCC only	0.00	0.49	3.94	\$38	\$9.5			0.0005
3	With carbon capture & storage - low cost estimates	0.00	3.68	29.46	\$238	\$8.1			0.0007
4	With carbon capture & storage - high cost estimates	0.00	4.08	32.62	\$1,369	\$42.0			0.0007

ES-6: IGCC with carbon capture and storage - Overall Results (displace existing coal)

Option #	Option Name	GHG Reductions (E6 tonnes CO2-equiv)			NPV of Costs (E6 2005\$)	Cost of Saved Carbon	2020 Rate impact (2005 cents/kWh)		
		2010	2020	Total (2007-2020)			Energy efficiency	Renewable energy	Total
ES-6b	IGCC with/without carbon capture and storage - replace existing 800 MW plant								
1	With carbon capture & - central cost estimates	0.00	5.36	42.86	\$1,696	\$39.6			0.0001
2	IGCC only	0.00	1.97	15.76	\$952	\$60.5			0.0000
3	With carbon capture & storage - low cost estimates	0.00	5.16	41.28	\$1,153	\$27.9			0.0002
4	With carbon capture & storage - high cost estimates	0.00	5.55	44.43	\$2,284	\$51.4			0.0001

ES-7: PBF - Approach Adopted at TWG #10

- Rate impact analysis needed as well as share of monthly household bills represented by the PBF
- Clarify overlap between RCI and ES concerning the PBF

ES-7: PBF - Overall Results

Option #	Option Name	GHG Reductions (E6 tonnes CO2-equiv)			NPV of Costs (E6 2005\$)	Cost of Saved Carbon	2020 Rate impact (2005 cents/kWh)		
		2010	2020	Total (2007-2020)			Energy efficiency	Renewable energy	Total
ES-7	Public benefits charge	0.82	3.42	24.36	(\$685)	(\$28.1)			0.0099

- Impact of mitigation option on monthly bills = 6.6 cents (2005)

ES-8: Waste to Energy - Approach Adopted at TWG #10

- Revise the analysis to consider a target of 50% of new sewage treatment facilities

ES-8: Waste to Energy - Overall Results

Option #	Option Name	GHG Reductions (E6 tonnes CO2-equiv)			NPV of Costs (E6 2005\$)	Cost of Saved Carbon	2020 Rate impact (2005 cents/kWh)		
		2010	2020	Total (2007-2020)			Energy efficiency	Renewable energy	Total
ES-8	waste-to-energy	0.00	0.00	0.02	(\$1)	(\$30.30)			0.0000

ES-10: GreenPower program - Approach Adopted at TWG #10

- Replace the targets that were proposed by the ES TWG with the targets proposed by the RCI TWG

ES-10: GreenPower program - Overall Results

Option #	Option Name	GHG Reductions (E6 tonnes CO2-equiv)			NPV of Costs (E6 2005\$)	Cost of Saved Carbon	2020 Rate impact (2005 cents/kWh)		
		2010	2020	Total (2007-2020)			Energy efficiency	Renewable energy	Total
ES-10	strengthening the NC Greenpower program								
1	Original analysis (default assumptions)	0.02	0.21	1.26	\$10	\$7.9			0.0010
2	Original analysis - low levelized cost estimate	0.02	0.21	1.26	\$18	\$14.4			0.0012
3	Original analysis - high levelized cost estimate	0.02	0.21	1.26	\$63	\$49.6			0.0020
4	Original analysis - CCS levelized cost estimate (2% solar PV set-aside)	0.02	0.21	1.26	\$12	\$9.9			0.0010
5	Original analysis - low levelized cost estimate (2% solar PV set-aside)	0.02	0.21	1.26	\$20	\$15.8			0.0012
6	Original analysis - high levelized cost estimate (2% solar PV set-aside)	0.02	0.21	1.26	\$61	\$48.2			0.0020

Public Input, Announcements

Next Proposed Activities

- Resolve any outstanding questions/issues by email and finalize all analyses one week prior to the next ES TWG meeting
- TWG members to provide input to CCS prior as needed via email/phone contact before then
- Date and time for next TWG meeting TBD