



EPA Analyses of Climate Legislation

Presentation to the California Air Resource Board

April 21, 2010

Reid Harvey, Chief

Climate Economics Branch

US EPA, Washington, DC



Modeling Approach

- For the purpose of this analysis, we have chosen to use two separate computable general equilibrium (CGE) models: IGEM and ADAGE.
- CGE models are structural models.
 - They build up their representation of the whole economy through the interactions of multiple agents (e.g. households and firms), whose decisions are based upon optimizing economic behavior.
 - The models simulate a market economy, where in response to a new policy, prices and quantities adjust so that all markets clear.
- These models are best suited for capturing long-run equilibrium responses, and unique characteristics of specific sectors of the economy.
- The general equilibrium framework of these models allows us to examine both the direct and indirect economic effects of the proposed legislation, as well as the dynamics of how the economy adjusts in the long run in response to climate change policies.
- Other models are used to provide information on abatement options that fall outside of the scope of the CGE models.
 - These models generate mitigation cost schedules for various abatement options.
- Additionally, the IPM model gives a detailed picture of the electricity sector in the short-run (through 2025), which complements the long-run (through 2050) equilibrium response represented in the CGE models.



Modeling Limitations

- The models used in this analysis do not incorporate the effects of changes in conventional pollutants (SO₂, NO_x, and Hg) on labor productivity and public health.
 - While this is an important limitation of the models, the impact on modeled costs of the policy is small because H.R. 2454 does not necessarily reduce overall emissions of conventional pollutants covered by existing cap and trade programs. Instead, allowance prices for conventional pollutants would fall.
- The federal government costs of administering H.R. 2454 (e.g. monitoring and enforcement) are not captured in this analysis.
- Household effects are not disaggregated by demographic characteristics (e.g. income class).
- Both of the CGE models used in this analysis are full employment models.
 - The models do not represent effects on unemployment.
 - The models do represent the choice between labor and leisure, and thus labor supply changes are represented in the models.
- While ADAGE does include capital adjustment costs, capital in IGEM moves without cost.
- IGEM is a domestic model; ADAGE has the capability of representing regions outside of the U.S., which were used to incorporate interactions between the U.S. and other countries. For consistency across analyses, international abatement options were generated in the following fashion:
 - We used the MiniCAM model to generate the supply and demand of GHG emissions abatement internationally.
 - For developing countries that are assumed to not have a cap on GHG emissions before 2025, and thus supply mitigation only through certified emissions reductions resulting from project activities, the potential energy related CO₂ mitigation supply is reduced by 90% through 2015, and by 75% between 2015 and 2025.
 - Combining the international demand for abatement from MiniCAM, the domestic demand for offsets determined by the limit on offsets, and the mitigation cost schedules for the various sources of offsets, allows us to find market equilibrium price and quantity of offsets and international credits.



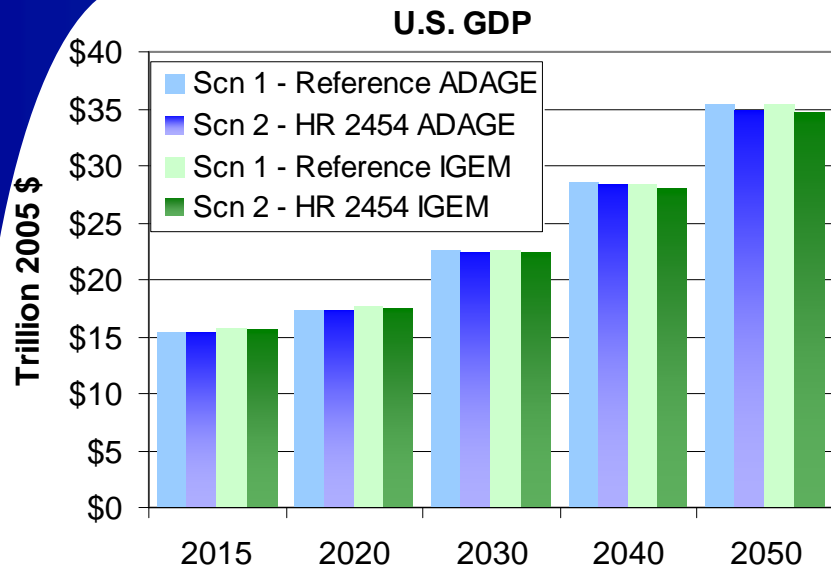
Modeling Key Provisions in AB 32 and HR 2454

	CARB Analysis	EPA Analysis
Energy Efficiency, Renewable Elec. Std.	Complementary Policies	IPM, ADAGE
Transportation	Complementary Policies	ADAGE, IGEM
Nuclear	n.a.	IPM, ADAGE, IGEM
CCS	n.a.	IPM, ADAGE, IGEM
Banking	Yes, 7%	Yes, 5%
Offsets	Limited to 50% of emission reductions	Limited to 2,000 million tons
Allowance Allocation	n.a.	ADAGE, IGEM

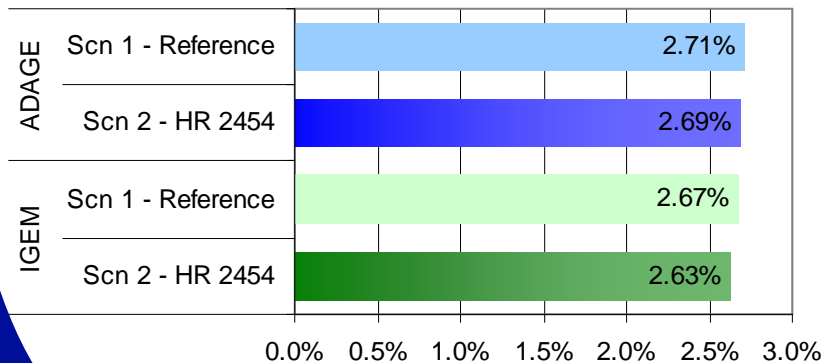


GDP

Scenario 1 – Reference & Scenario 2 – H.R. 2454



Average Annual GDP Growth Rate (2010 - 2030)



ADAGE

	2015	2020	2030	2040	2050
Reference	\$15.4	\$17.4	\$22.6	\$28.6	\$35.4
Scn 2 - H.R. 2454	\$15.4	\$17.5	\$22.5	\$28.4	\$34.9
Absolute Change	\$0.013	\$0.023	-\$0.083	-\$0.208	-\$0.459
% Change	0.08%	0.13%	-0.37%	-0.73%	-1.30%

IGEM

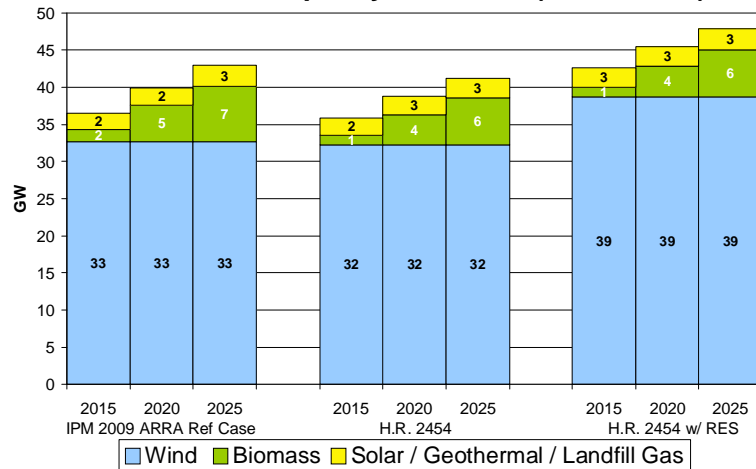
	2015	2020	2030	2040	2050
Reference	\$15.7	\$17.7	\$22.7	\$28.5	\$35.4
Scn 2 - H.R. 2454	\$15.7	\$17.6	\$22.5	\$28.0	\$34.7
Absolute Change	-\$0.067	-\$0.101	-\$0.241	-\$0.425	-\$0.727
% Change	-0.43%	-0.57%	-1.06%	-1.49%	-2.05%

- Other ways to frame these GDP reductions are as follows:
 - In the reference case, GDP in ADAGE is \$22.6 trillion in 2030. In “scenario 2 – H.R. 2454” GDP reaches \$22.6 trillion approximately two months later than in the reference case.
 - In IGEM the reference case GDP is \$22.7 trillion in 2030. In “scenario 2 – H.R. 2454” GDP reaches \$22.7 trillion five months later than in the reference case.
 - Under “scenario 2 – H.R. 2454”, average annual GDP growth between 2010 and 2030 is approximately 2 basis points lower in ADAGE and 4 basis points lower in IGEM than in the reference scenario.

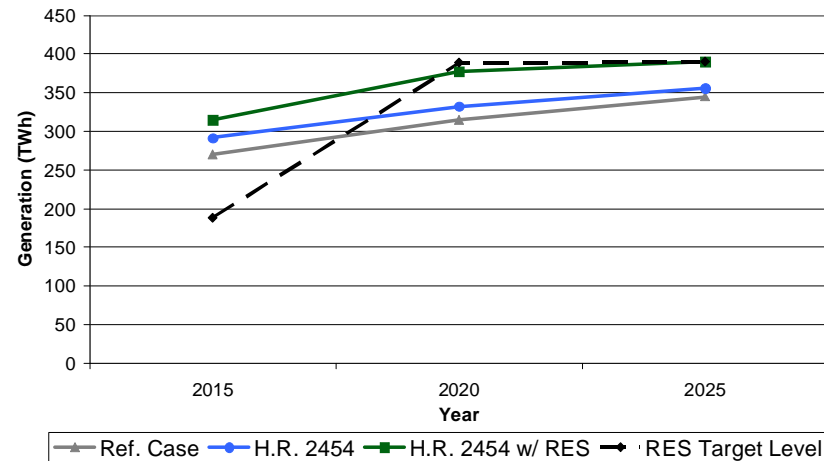


Effects of the Combined Efficiency and Renewable Electricity Standard (IPM)

Renewable Capacity Additions (Cumulative)



Qualifying RES Generation



- The core case for H.R. 2454 illustrates how the bill's provisions for increased energy efficiency reduce the need for new capacity additions (including renewables), even as renewable generation rises. The RES portion of CERES is shown here to increase deployment of renewable capacity, and it results in a more substantial increase in renewable generation than the cap-and-trade system yields on its own.
 - The RES also reduces average natural gas prices, gas consumption, and wholesale electricity prices by about 1-2% throughout the model's time horizon. Initial analysis indicates that retail electricity prices rise slightly relative to the core H.R. 2454 scenario in later years. The impact on a household's electricity bill, however, would be offset to the extent that efficiency gains would reduce overall power consumption.
 - The share of renewable electricity (as defined by the RES) in the IPM reference scenario is roughly 7% of generation in 2020 and 2025. In Scenario 2 (H.R. 2454), the renewable generation share increases to 8% in 2020 and 9% in 2025. And in Scenario 2 with the RES, renewable generation is 9% in 2020 and 10% in 2025.
- The power sector is projected to reach the bill's RES targets through 2015 in the reference case (with 25% from electricity savings assumed).
- H.R. 2454 includes an alternative compliance payment (ACP) of \$25 per MWh. This analysis projects that the federal Renewable Electricity Credit (REC) price reaches that level in 2020 but falls back to about \$11 per MWh in 2025.
 - Use of the ACP in 2020 is very limited (accounting for only 2% of total CERES compliance).
 - H.R. 2454 also allows States to petition for the right to meet up to 40% of the CERES with electricity savings. Additional use of efficiency to meet the standards would lower federal Renewable Electricity Credit (REC) prices, potentially reducing use of the ACP.
 - This analysis does not take into account the effect of ACP payments, which H.R. 2454 reserves for States to increase the deployment of renewables or increase electricity savings.
- By increasing the share of renewable generation, the RES would likely lower power sector GHG emissions and could lower the economy-wide allowance price, although this effect was not modeled in the analysis. To the degree that the RES requires generation or capacity deployment that is not most cost effective otherwise, total system costs increase. RES would not impact the achievement of the emission caps under H.R. 2454.

Note: IPM 2009 ARRA Reference Case is generally consistent with AEO 2009 (ARRA update), although projections are not identical because IPM is a power sector model and has different treatment of key assumptions and variables. For more detail on natural gas impacts of the RES, see slide 93 of the Appendix.



Cost of Inaction

- The Council of Economic Advisors calculated that the House-passed energy and climate bill would result in approximately \$1.6 trillion to \$2.0 trillion of avoided global damages in present value terms between 2012 and 2050 (in 2005 dollars).
- The value of avoided damages dwarfs any credible calculation of the regulatory cost of the legislation.
- It includes such benefits as lower mortality rates, higher agricultural yields, money saved on adaptation measures, and the reduced likelihood of small-probability but high-impact catastrophic events.

Source: Council of Economic Advisors, Economic Report of the President, p 254



Thank You!

EPA Analyses on the web:

<http://www.epa.gov/climatechange/economics/economicanalyses.html>

Contact Info:

Harvey.reid@epa.gov

(202) 343-9429



H.R. 2454 – Bill Summary

Title I

- *Title I – Clean Energy*
 - *Subtitle A - Combined Efficiency and Renewable Electricity Standard*
 - Sec. 101 requires utilities that sell more than 4 million megawatt hours of electricity to consumers to meet a certain percentage (6% in 2012 rising to 20% in 2020) of their load electricity generated from renewable resources and energy savings. Up to one quarter (or two-fifths upon petition) of the requirement can be met with energy savings.
 - This provision is modeled in IPM. In ADAGE, the energy savings portion of the RES is modeled, but not the renewable electricity portion. IGEM does not model this provision.
 - *Subtitle B - Carbon Capture and Sequestration*
 - Sec. 114 creates a Carbon Capture and Sequestration (CCS) demonstration early deployment program.
 - This provision is modeled in IPM, but not in ADAGE or IGEM.
 - Sec. 115 promotes the commercial deployment of CCS technologies through a bonus allowance program.
 - This provision is modeled in ADAGE, IGEM, and IPM.
 - *Subtitle C - Clean Transportation*
 - *Subtitle D - State Energy and Environmental Deployment Accounts*
 - Sec. 131 establishes SEED Accounts to serve as a state-level repository for managing and accounting for all emissions allowances designated primarily for renewable energy and energy efficiency purposes.
 - Sec. 132 distributes emission allowances among states for energy efficiency and renewable energy deployment and manufacturing support.
 - The energy efficiency portions of Sec 131 and 132 are modeled in ADAGE and IPM, but not in IGEM.
 - *Subtitle E - Smart Grid Advancement*
 - *Subtitle F - Transmission Planning*
 - *Subtitle G - Technical Corrections to Energy Laws*
 - *Subtitle H - Energy and Efficiency Centers*
 - *Subtitle I - Nuclear and Advanced Technologies*
 - *Subtitle J - Miscellaneous*
- Title I, Subtitles C, E, F, G, H, I, and J are not modeled in this analysis.



H.R. 2454 – Bill Summary

Title II

- *Title II – Energy Efficiency*

- *Subtitle A - Building Energy Efficiency Programs*

- Sec. 201 establishes energy efficiency targets of 30% reduction below 2006 IECC by enactment, 50% reductions by Jan 1, 2014 (residential) and 2015 (commercial) and increasing 5% every three years thereafter until 2029 (residential) and (commercial)

- This provision is modeled in ADAGE. IGEM does not model this provision.

- Sec. 202 establishes the Retrofit for Energy and Environmental Performance (REEP) program for residential buildings, and another for commercial, funded by allowances, to provide loans certification, and other support

- This provision is modeled in ADAGE. IGEM does not model this provision.

- Sec 203 assistance for homeowners living in manufactured homes built before 1976 to purchase new energy efficient manufactured homes

- This provision is modeled in ADAGE. IGEM does not model this provision.

- Sec 204 creates a building energy performance labeling program

- This provision is modeled in ADAGE. IGEM does not model this provision.

- *Subtitle B - Lighting and Appliance Energy Efficiency Programs*

- *Subtitle C - Transportation Efficiency*

- *Subtitle D - Industrial Energy Efficiency Programs*

- *Subtitle E - Improvements in Energy Savings Performance Contracting*

- *Subtitle F - Public Institutions*

- *Subtitle G - Miscellaneous*

- Title II, Subtitles B, C, D, E, F, and G are not modeled in this analysis.