Optimal Strategies for Achieving the Objectives of the American Clean Energy and Security Act

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Prepared for:

Natural Resources Defense Council
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PRESENTATION OUTLINE

- American Clean Energy and Security Act
- US National MARKAL Model: USNM-50
- Technology Pathways and Policies
- System Cost and Energy security Impacts
- Sensitivity Runs

American Clean Energy and Security Act

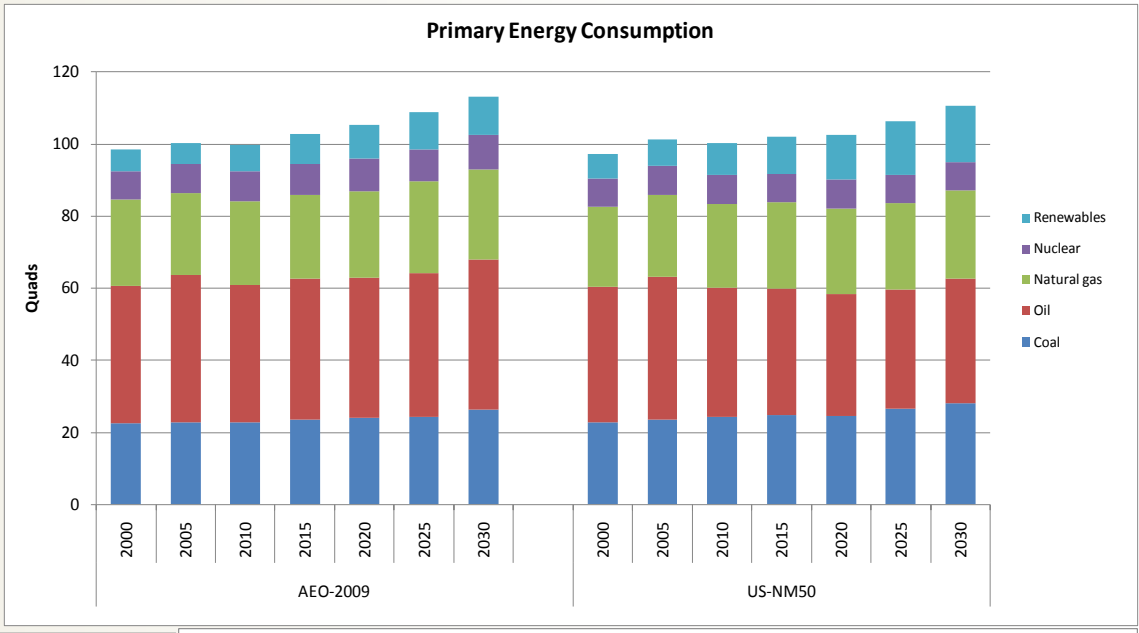
- Also referred to as the Waxman-Markey bill
- Calls for an 80% reduction in US greenhouse gas emissions by 2050
- Includes a variety of incentives to help achieve this ambitious objective
  - Carbon capture and sequestration (CCS)
  - Energy efficiency
  - Renewable electricity standard
- IRG investigated cost-effective strategies to achieve the bills objectives of the USCAP 2.0 initiative (www.nrdc.org/cap2.0)

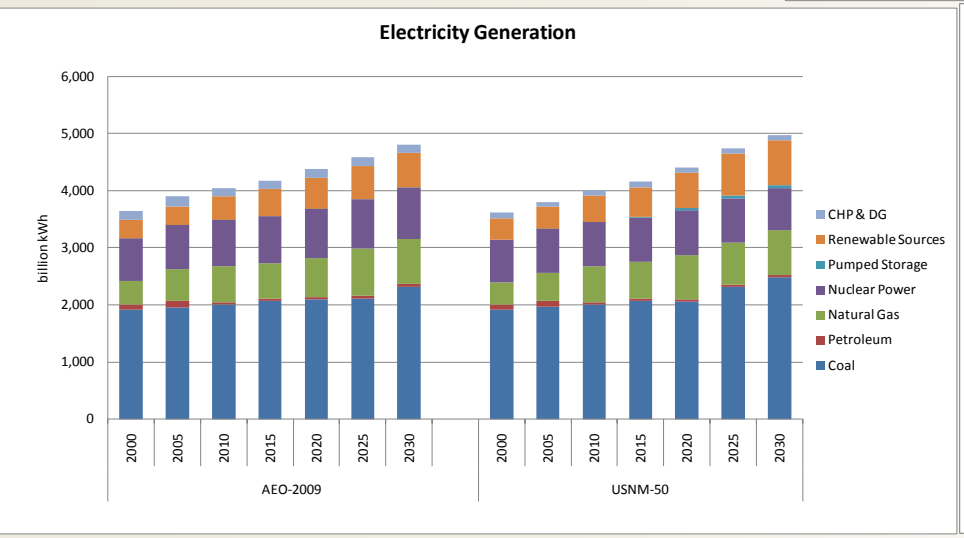
US-NM50: A Comprehensive National Energy Policy Analysis Model

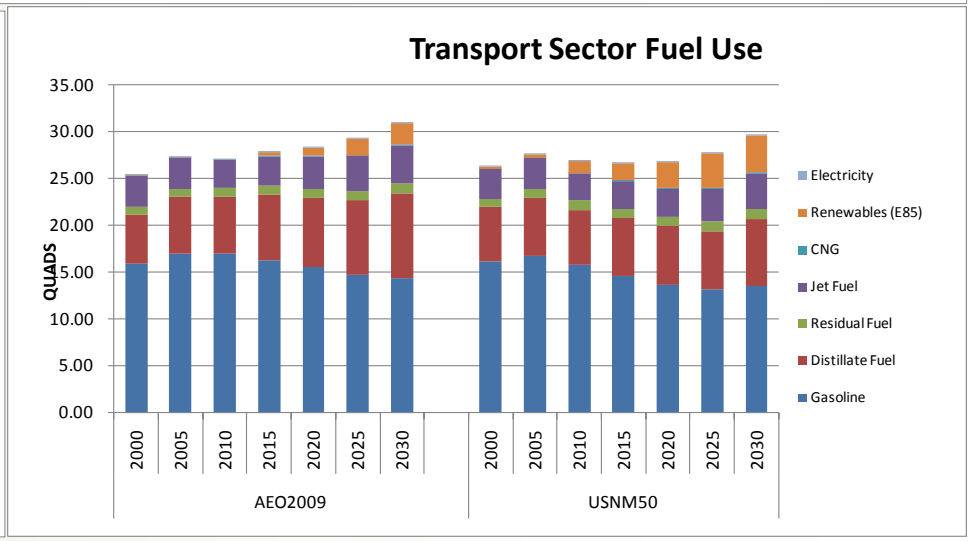
- Extended and updated US EPA national MARKAL model
- Base period is 2000 and final period is 2050, with 2000 and 2005 calibrated to historical data
- Resource supply curves and demand projections based on AEO2009 Published Release, modified to reflect the Stimulus Bill
- Full depiction of all demand sectors (commercial, residential, industrial and transportation)
- Reference or business-as-usual (BAU) case 2010-2030 compares closely to AEO2009
- Renewable, carbon capture and sequestration (CCS), advance nuclear and hydrogen production technologies subject to endogenous technology learning
- All demands endogenously adjusted based upon own-price elasticities
- Compares energy use and prices, technology choice, system cost, security of supply, CO_2 marginal costs, etc.

Comparison to AEO2009

USNM-50 results match AEO2009 closely. Primary energy, electric generation and sectoral fuel use all are within 4% except transportation, where USNM-50 shows faster fleet efficiency improvement and more ethanol use than NEMS predicts

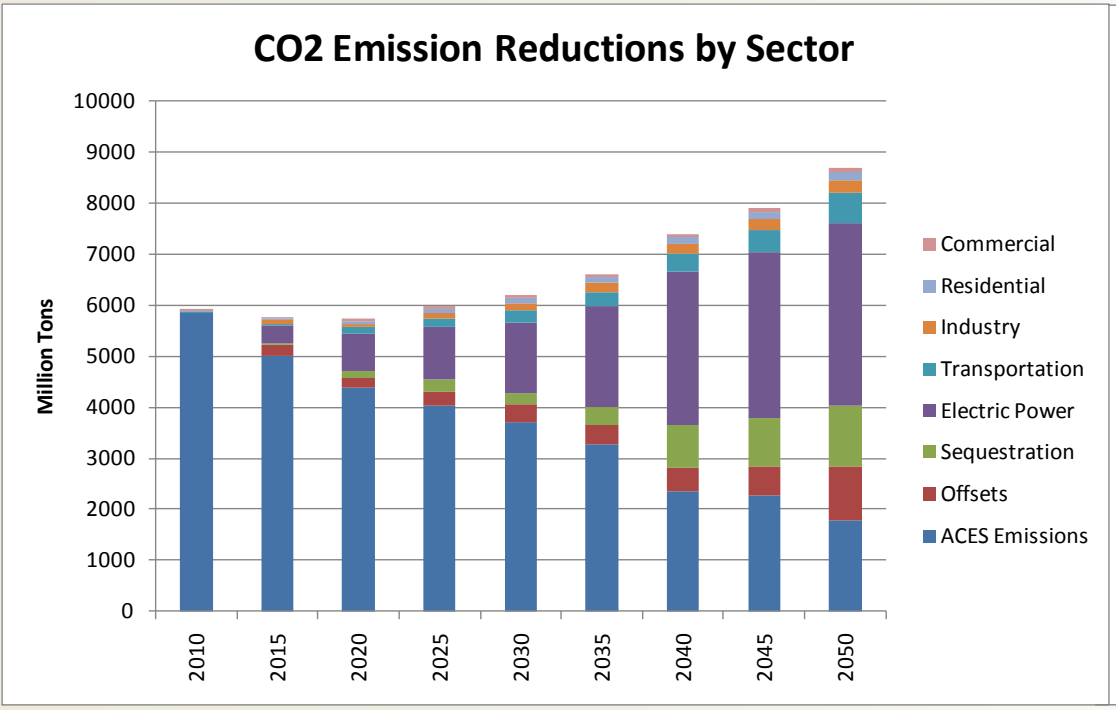


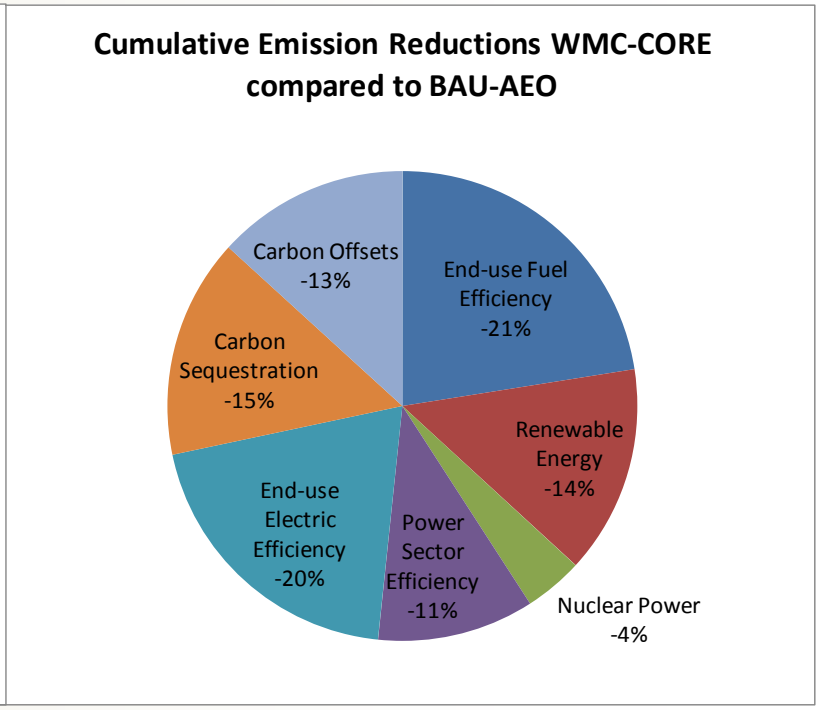




Breakdown of Emission Reductions

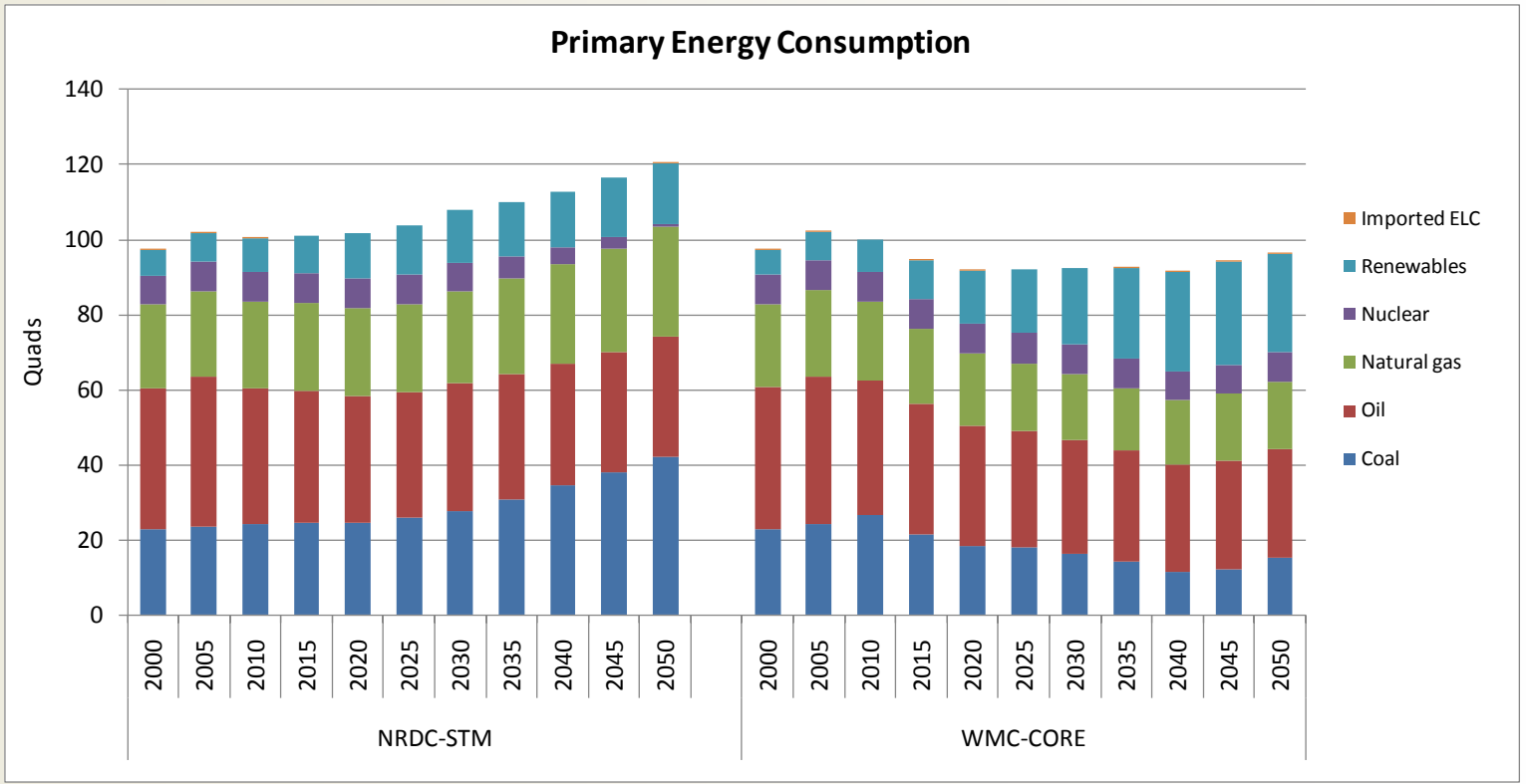
- Cumulative emission reductions are 142 Gt CO_2
- Most emission reductions come from Power and Transport sectors
- Most emission reductions result from efficiency, sequestration, renewable energy and offsets





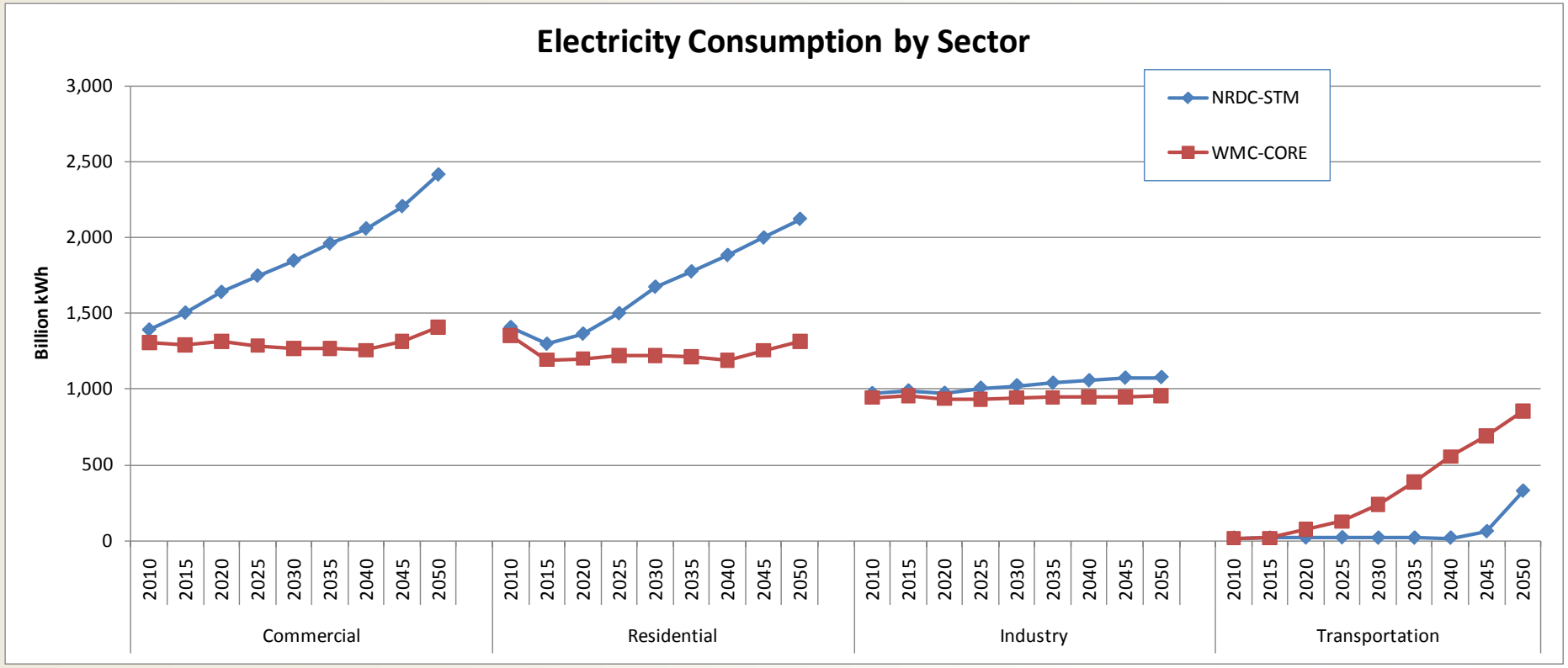
PRIMARY ENERGY USE UNDER ACES

- 20% lower under Cap and Trade than in the BAU
- Coal declines from 27 quads in 2020 to 15 quads in 2050
- Oil and natural gas use are reduced from the BAU case
- Nuclear use remains constant
- Renewable energy use increases to 26 quads by 2050



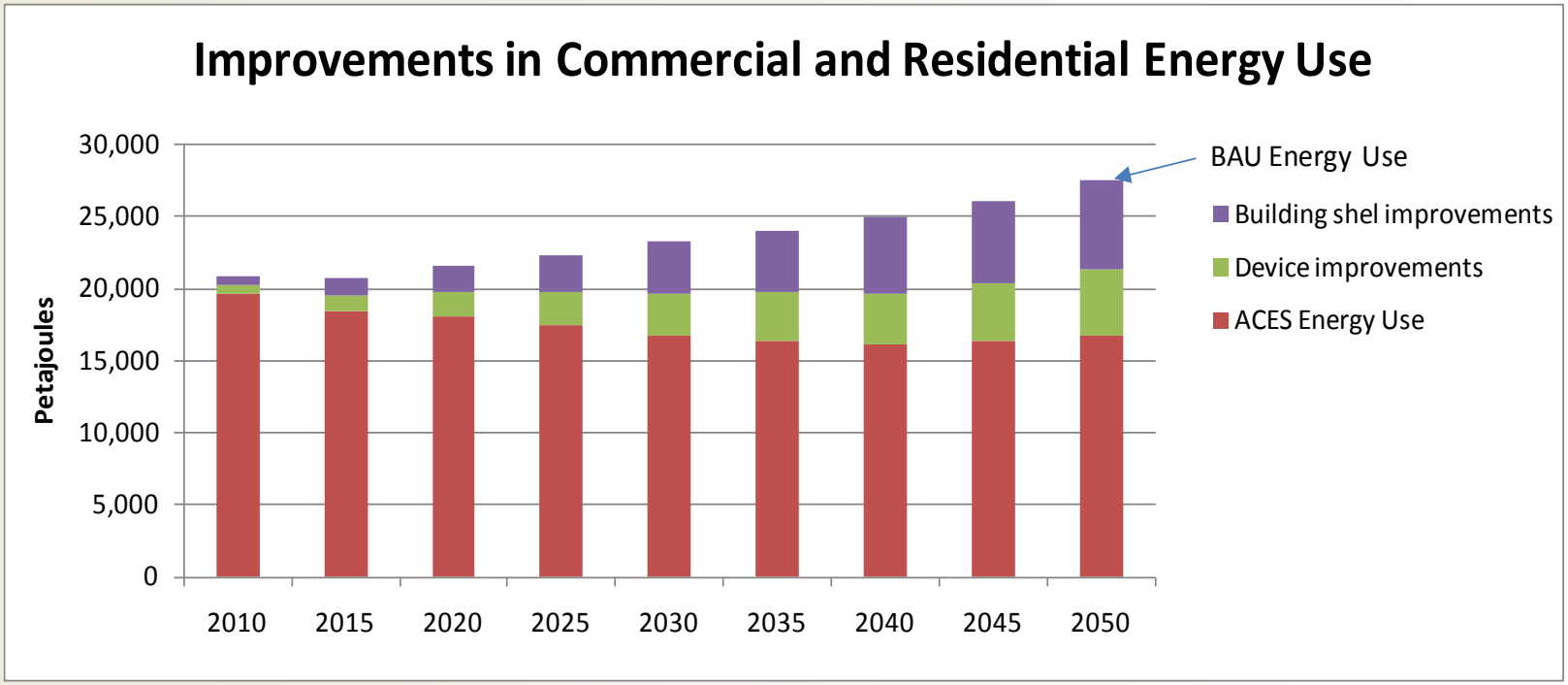
Electricity consumption

- Residential and commercial electricity consumption decreases by about 40% compared to the BAU
- Transport electricity consumption increases dramatically to supply plug-in hybrids



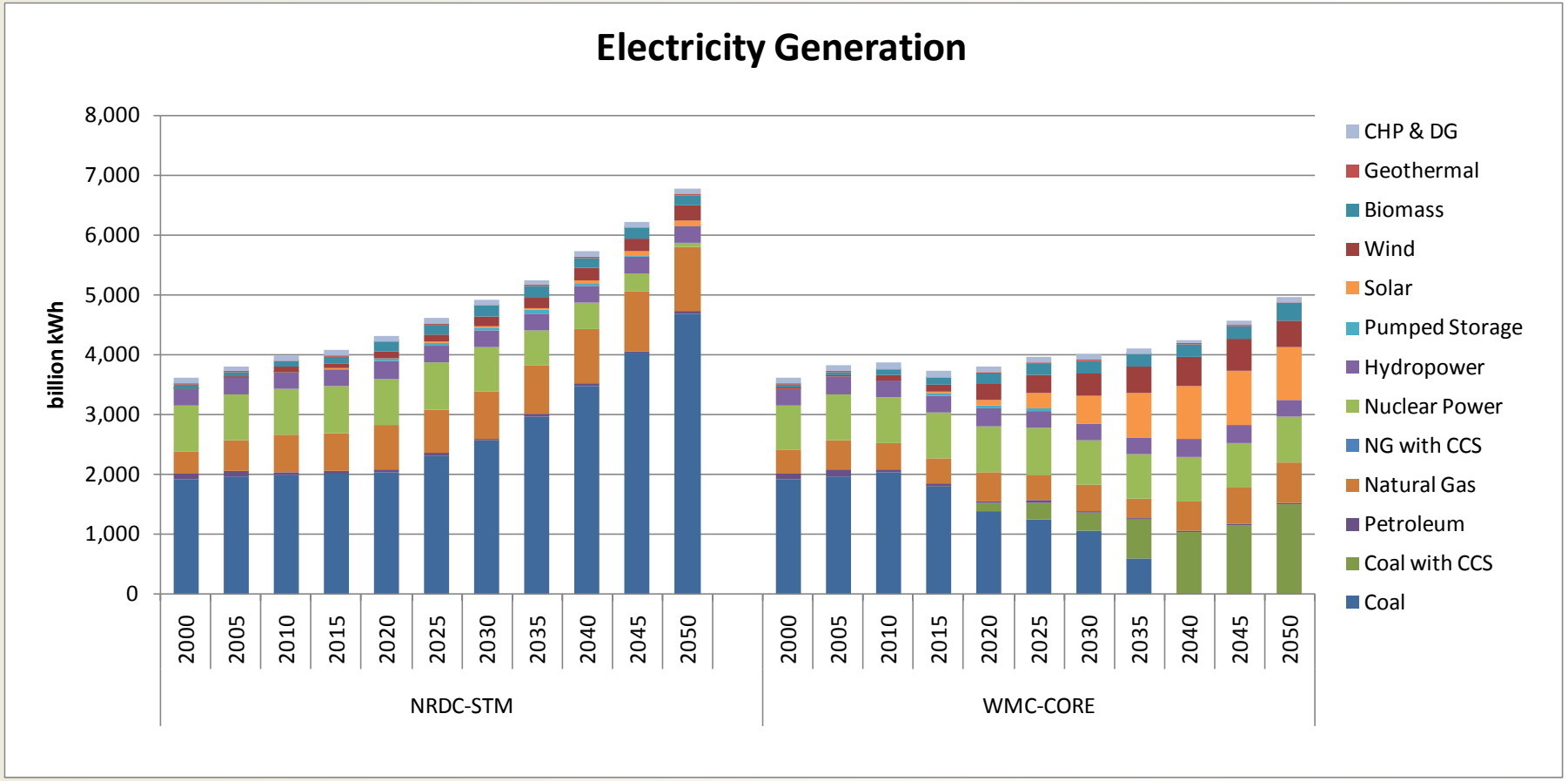
Residential and Commercial Energy Use

- Reductions are due
  - 56% to building shell improvements and
  - 44% to end-use device improvements



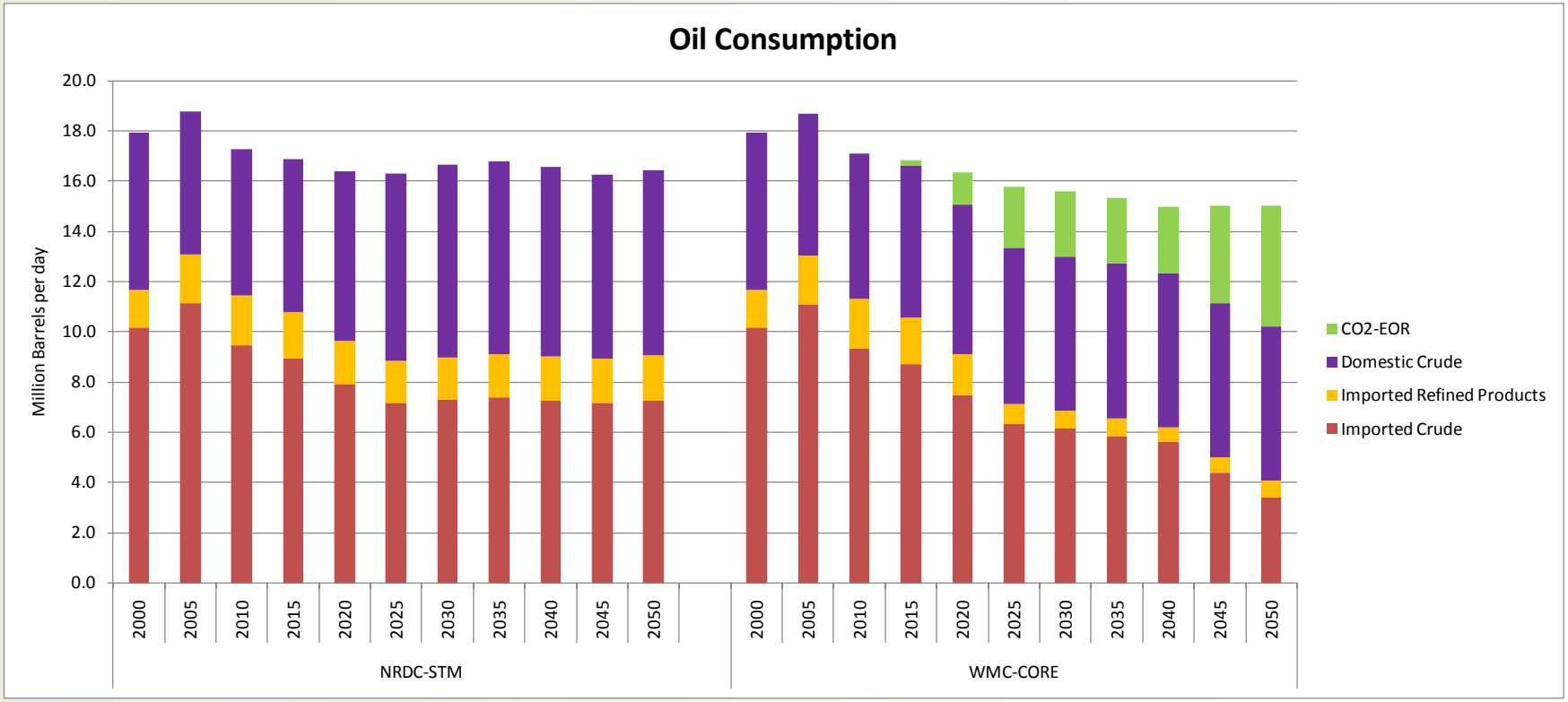
Electricity Generation

- Coal use transitions from combustion to gasification with CCS starting in 2020; Natural gas is replaced with renewables, except for peaking considerations, and nuclear power grows slightly due to upgrades at existing plants only. Non-hydro renewables grow to 33% of supply.



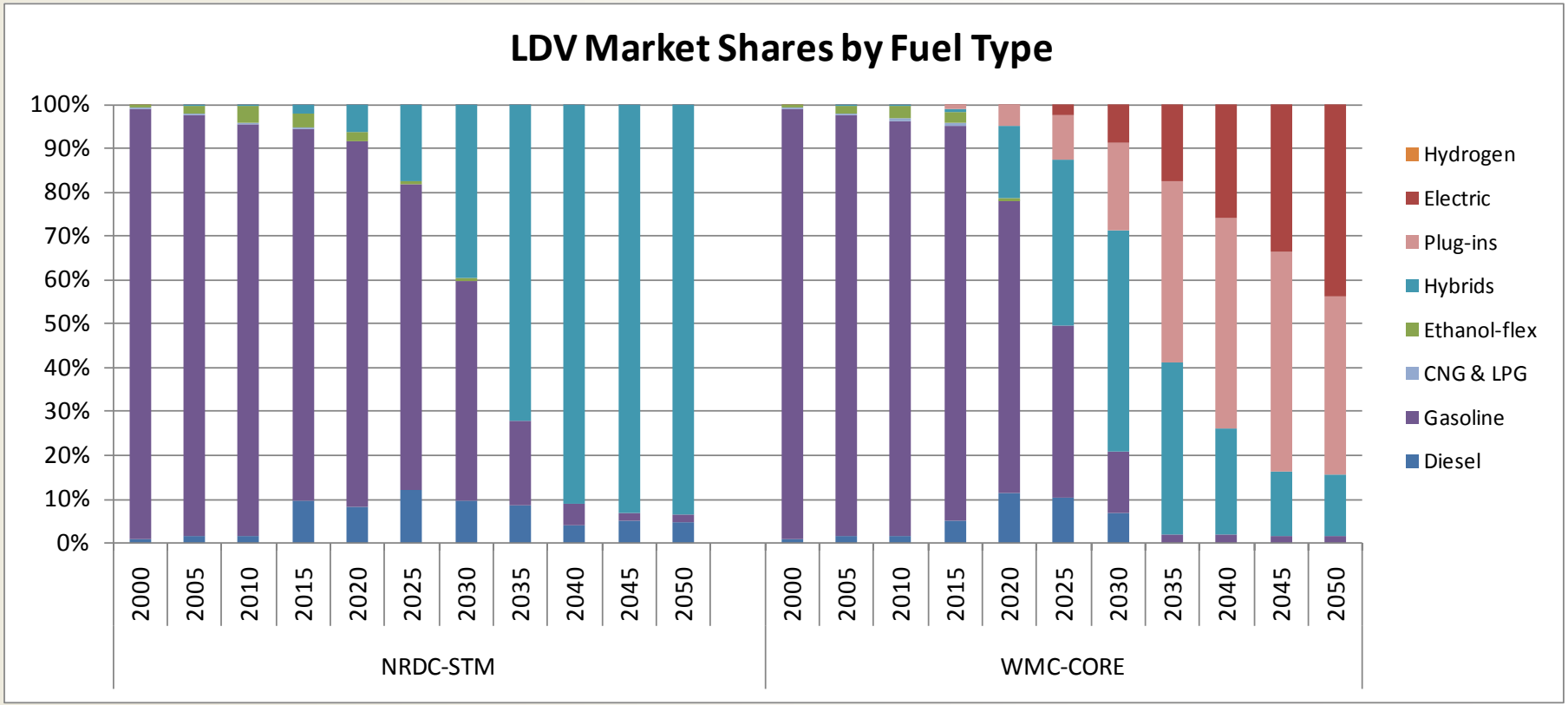
Oil Imports

- Oil imports drop to 27% of total consumption in 2050 due to both lower demand and the use of CCS for Enhanced Oil Recovery (EOR). Incentives in ACES help to stimulate the implementation of CCS technology and result in a deployment of CCS above the level that can be used for EOR.



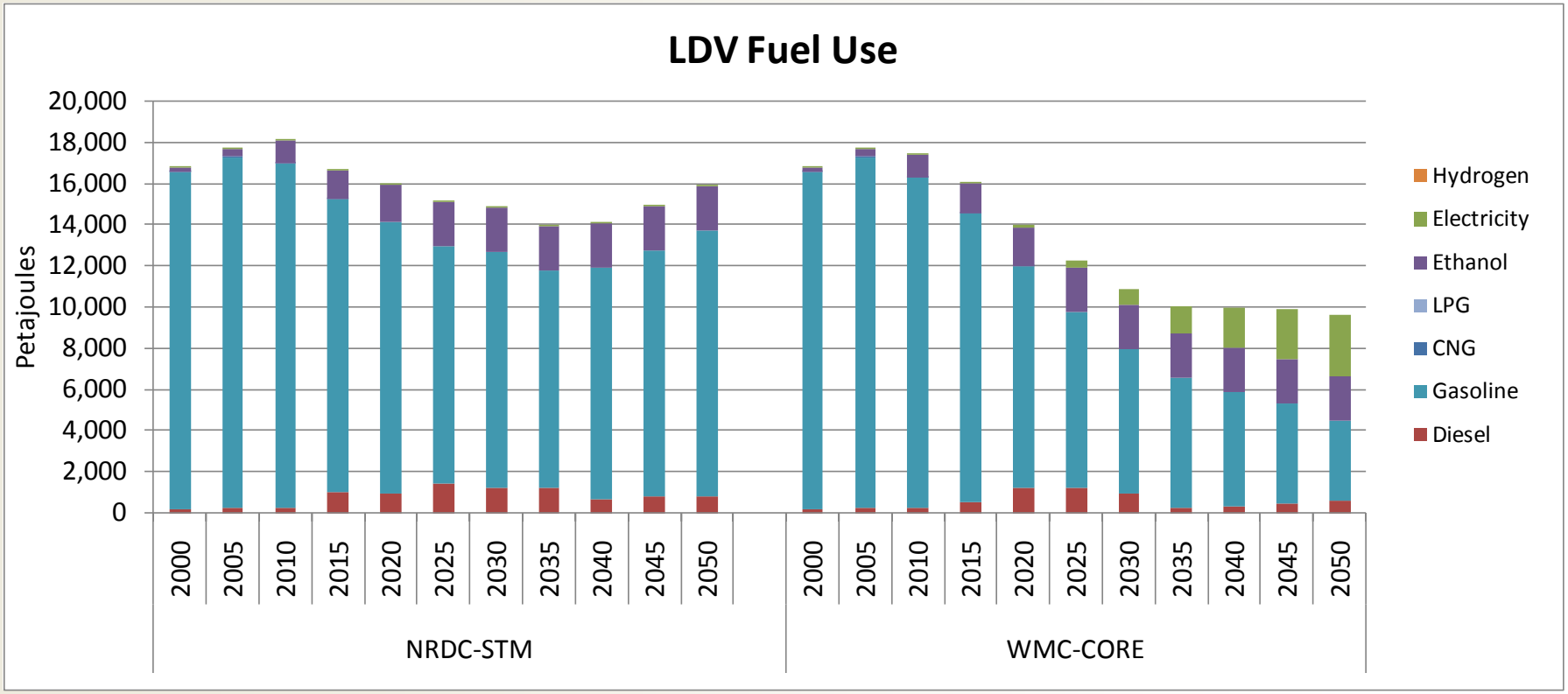
Light Duty Vehicles Types

- The NRDC reference case shows a transition to hybrids with new vehicle efficiency reaching 46 mpg in 2050.
- Under ACES, the LDV fleet transitions from hybrids to plug-ins running flexibly on ethanol and gasoline with electric vehicles entering in 2030.
- New LDV efficiency approaches 80 mpg in 2050.



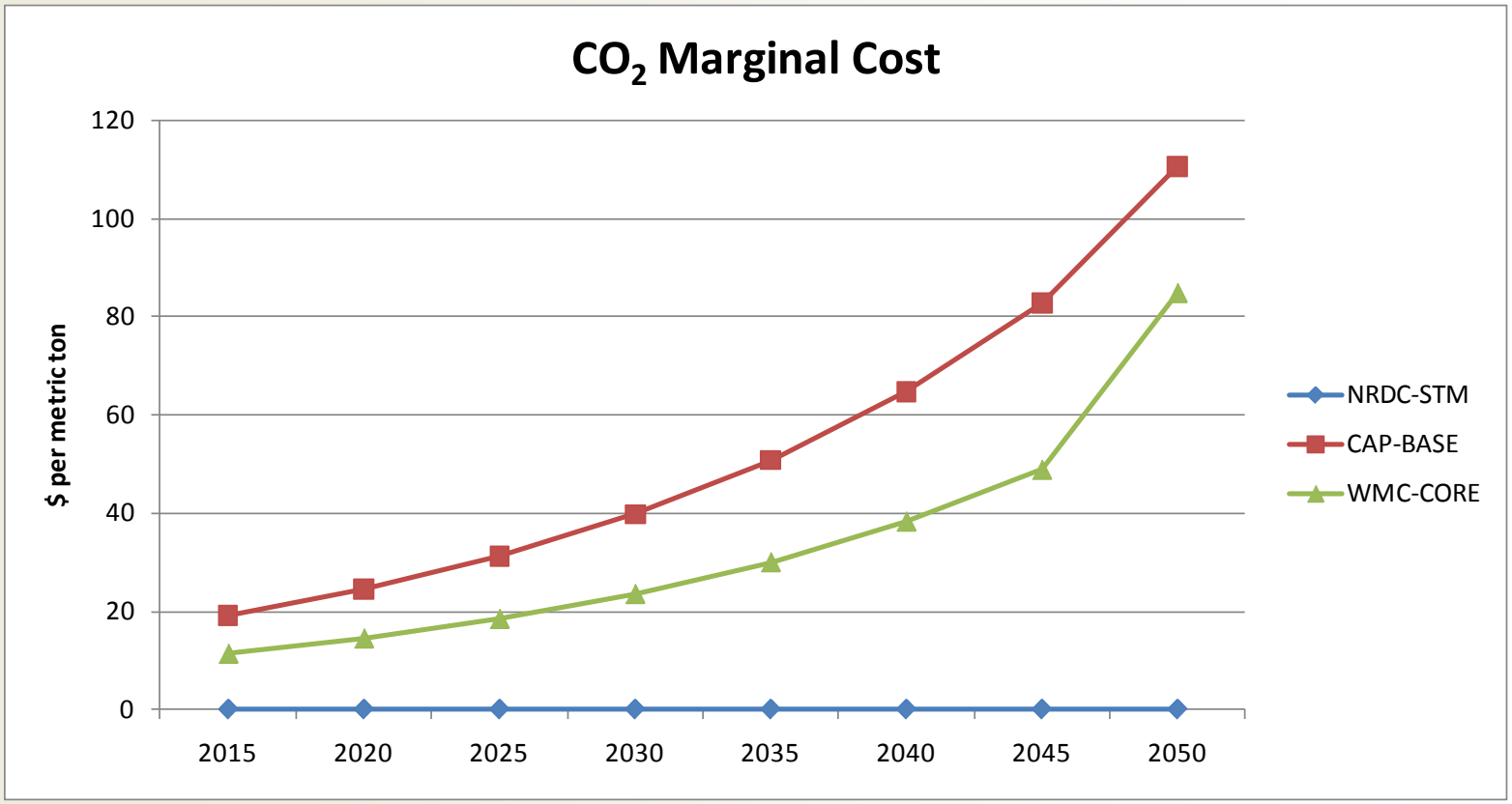
Light Duty Vehicle Fuel Use

- The NRDC reference case gasoline use declines as hybrids enter the market but that is overcome by demand growth after 2040.
- Under ACES, gasoline decreases to about 40% of all LDV fuel use, with electricity (decarbonized) accounting for 30%.



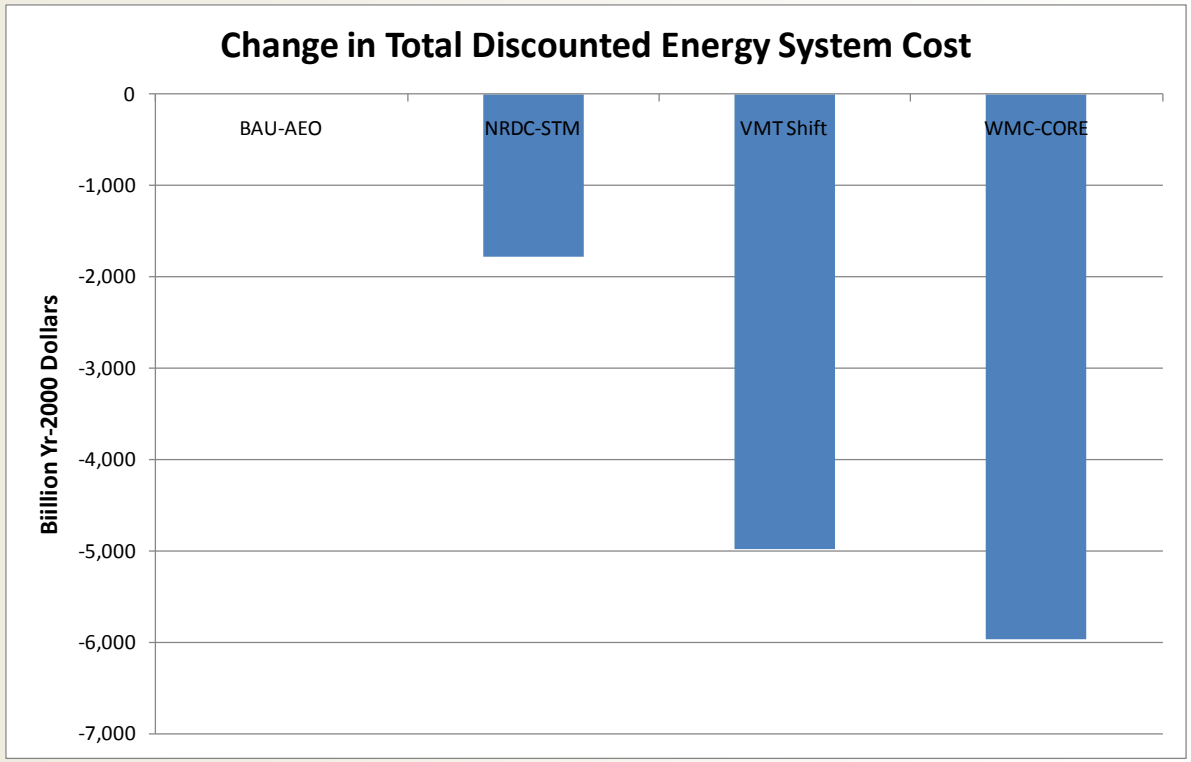
CO_2 Allowance Prices

- Under ACES, CO_2 allowance prices are $14/ton in 2020, increasing to almost $24/ton in 2030 and $85 per ton in 2050.
- Without the policies and incentives in ACES, CO_2 allowance prices would be $24/ton in 2020, $40/ton in 2030 and $110 per ton in 2050.



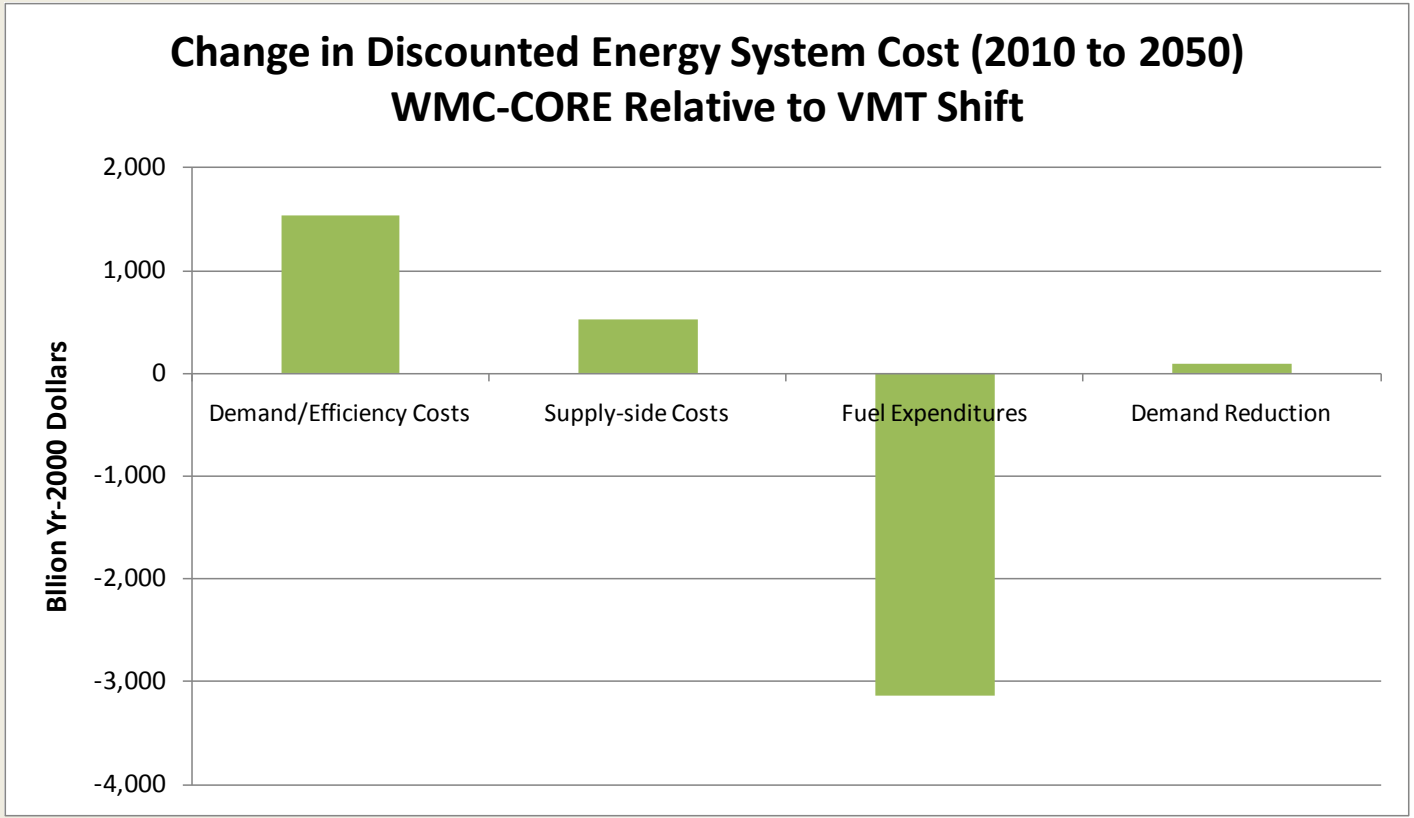
Discounted Energy System Cost

- NRDC assumptions relative to efficiency adoption result in savings relative to AEO2009.
- ACES policies for transport systems are projected to reduce vehicle miles traveled (VMT) by 5% in 2020, 8% in 2030 and 12% in 2050.
- Implementation of ACES results in additional savings due to greater adoption of efficiency measures.



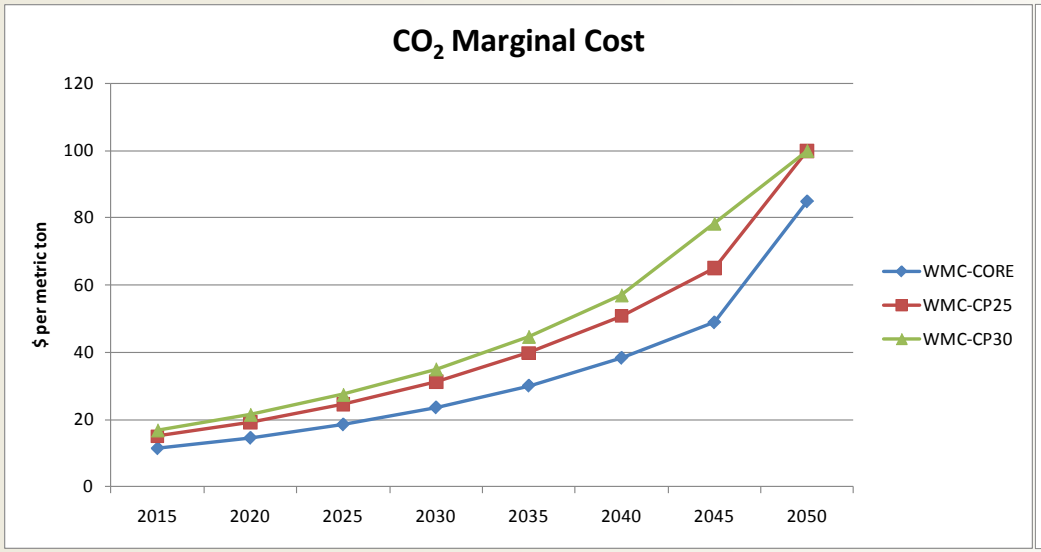
Strategies to Achieve ACES Goals

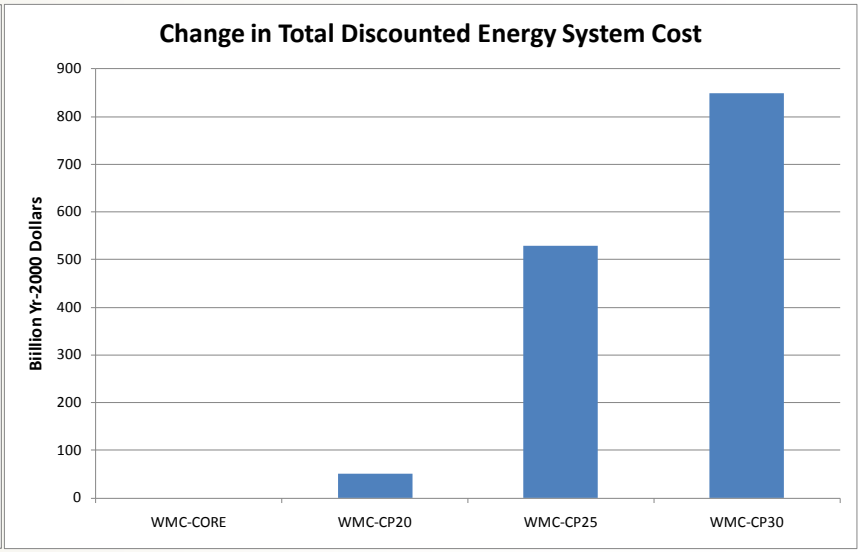
- Achieving ACES goals requires significant incremental investments in end-use device efficiency and building shell improvements, coupled with additional incremental investments in clean supply technologies, resulting in savings in fuel expenditures which more than offset the investments and yield a net savings.



Sensitivity 1: More Stringent Caps

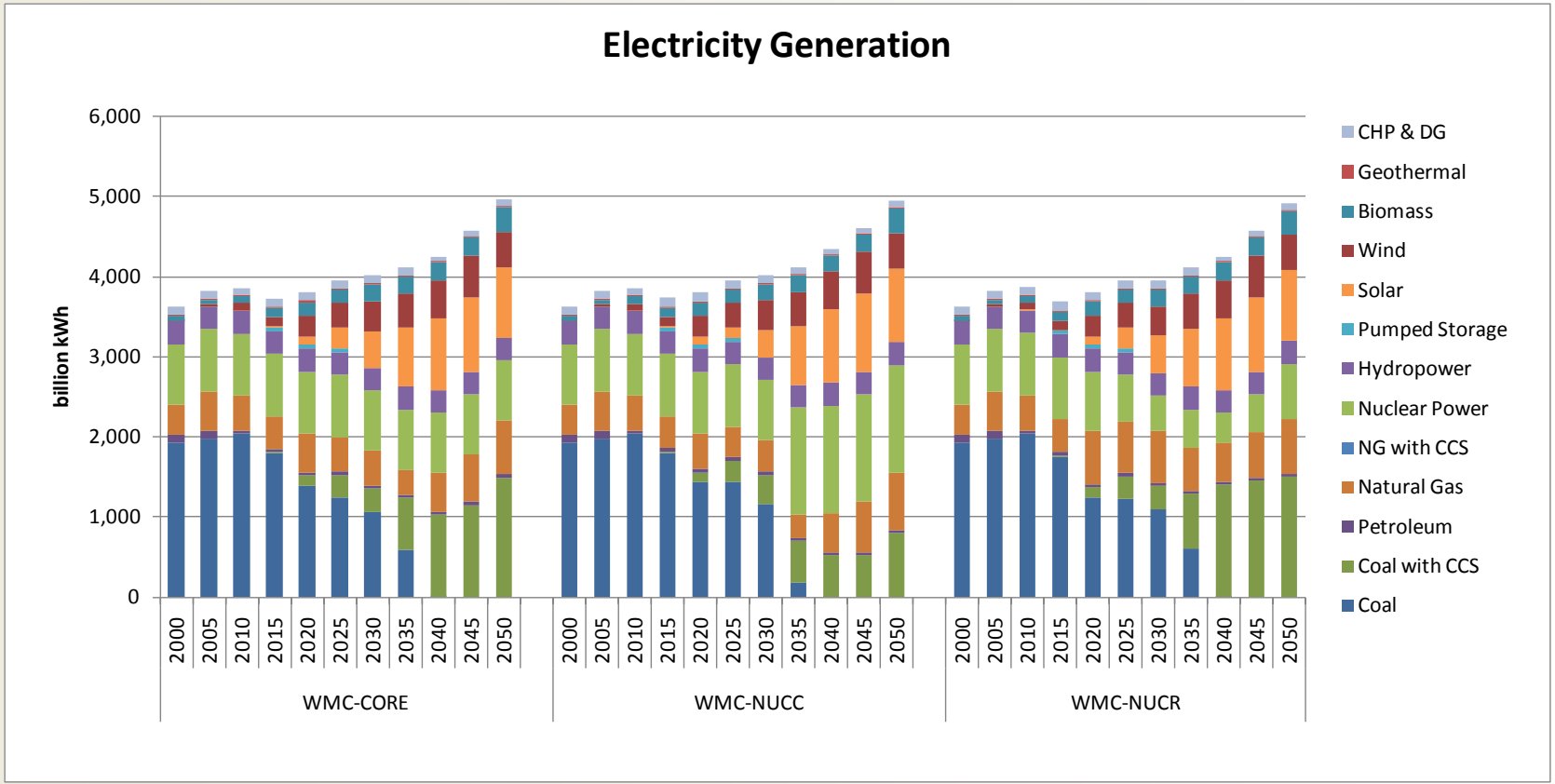
- 20% Cap in 2020 is achievable with minimal incremental cost
- 25% Cap in 2020 increasing to 45% in 2030 and 85% in 2050 is achievable, but reduces the energy system cost savings by half and increases CO_2 prices by $5 to $15 per ton.
- 30% Cap in 2020 increasing to 50% in 2030 and 90% in 2050 is also achievable, but eliminates most of the energy system cost savings and increases CO_2 prices by $7 to $30 per ton.





Sensitivity 2: Nuclear Power

- Reducing the investment cost for new nuclear power plants by 15% produces a new build of about 80 GW, which comes mostly from coal with CCS. System cost does not change.
- Reducing the life expectancy of existing nuclear plants to 50 years significantly increases coal with CCS. System cost increases by $250B



Conclusions

- ACES CO_2 reduction targets are achievable without an increase in total discounted energy system cost, but major technology transitions are required.
- Achieving CO_2 reduction targets through energy efficiency, renewables and CCS-supplied Enhanced Oil Recovery has the added benefit of substantially reducing dependence on foreign oil.
- Least-cost reduction path focuses on early and steady reductions in the electric sector through rapid promotion of energy efficiency, early development of renewable energy and strong deployment of CCS technology starting in 2020.
- The nation's LDV fleet must transition to hybrid, plug-in and electric vehicles running flexibly on ethanol, gasoline and electricity.
- Limited use of domestic offsets and international credits significantly reduce compliance costs but additional offsets are of little benefit.