Sustainable Energy Scenarios and the Role of Renewable Energy

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Renewable Energy: From Analysis to Action
A workshop hosted by
IEA Renewable Energy Working Party &
IEA Renewable Energy Technology Deployment Implementing Agreement

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75016 Paris

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Overview of RETD Activities

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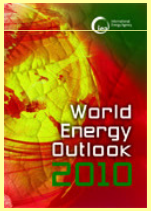
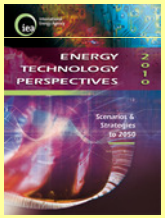
Since 2007, RETD has been examining the role of RE and climate change in global energy system modeling.

Expert input & peer review

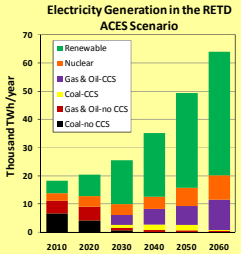
- WEO 2008, 2009 & 2010
- ETP 2008 & 2010





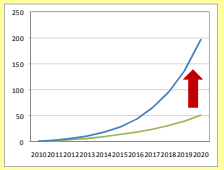
Independent scenario modeling and analysis

- Aggressive climate action (400ppm CO_2-eq)
- Initial integration of security issues
- Climate change adaptation & fossil fuel dependence



Moving from analysis to action

- Strategies to accelerate near-term RE deployment



The evolving energy system has made modeling more complex, yet more important than ever.

Historical Modeling Focus	*Current Modeling Topics*
• Energy supply & demand	• Climate change mitigation • Energy security • How to achieve price stability
• Large-scale, slowly changing technologies • Traditional business models/economic analysis	• Rising role of RE & DG • Potential for disruptive change • New business models
• Energy system modeled in isolation	• Comprehensive costs & benefits of energy system transformation

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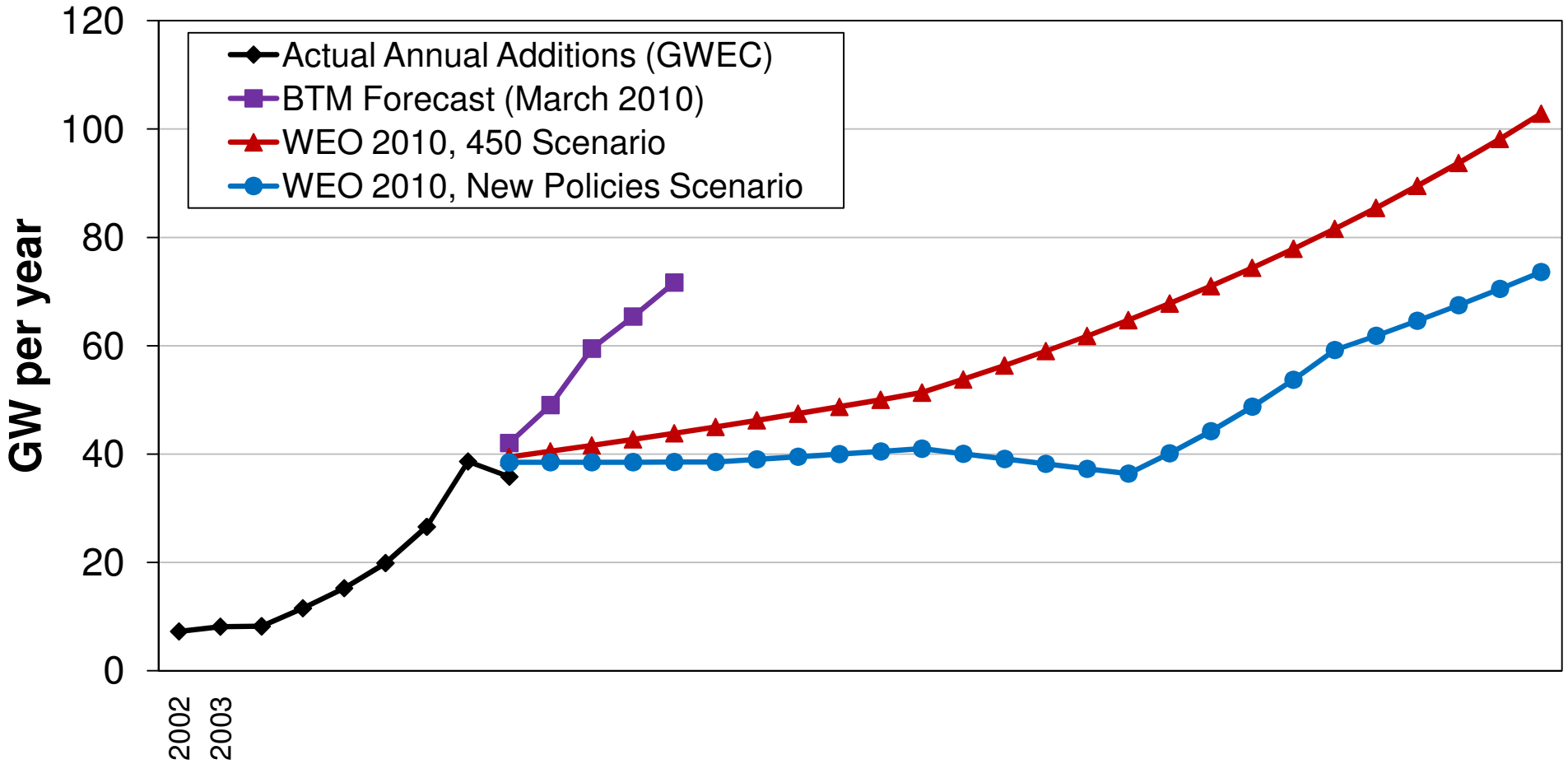
The IEA's work on energy system modeling has evolved significantly in the last three years.

Critical Issue	Key Progress Made	Remaining Concerns & Needs
Scenario Framing	• Better scenario definitions • Full modeling of 450ppm scenario	• Scenarios with deeper GHG cuts • Explicit consideration of security
Transparency	• Better dissemination of detailed results for all scenarios and technology assumptions	• Presentation of energy system costs is incomplete • Key message (that climate change mitigation is a "bargain") is not clear enough
Role of RE	• More robust assessment of role of RE	• Results still underestimate likely RE contribution • Fossil fuel technology costs too low
Modeling full costs and benefits	• Need for action on GHG reduction is clearly articulated • Specific benefits are increasingly covered in WEO and ETP discussion (but not modeled)	• Emphasis is still on "cost" of mitigation and assumed GDP loss. • Need models capable of quantifying all costs & benefits for a complete economic picture

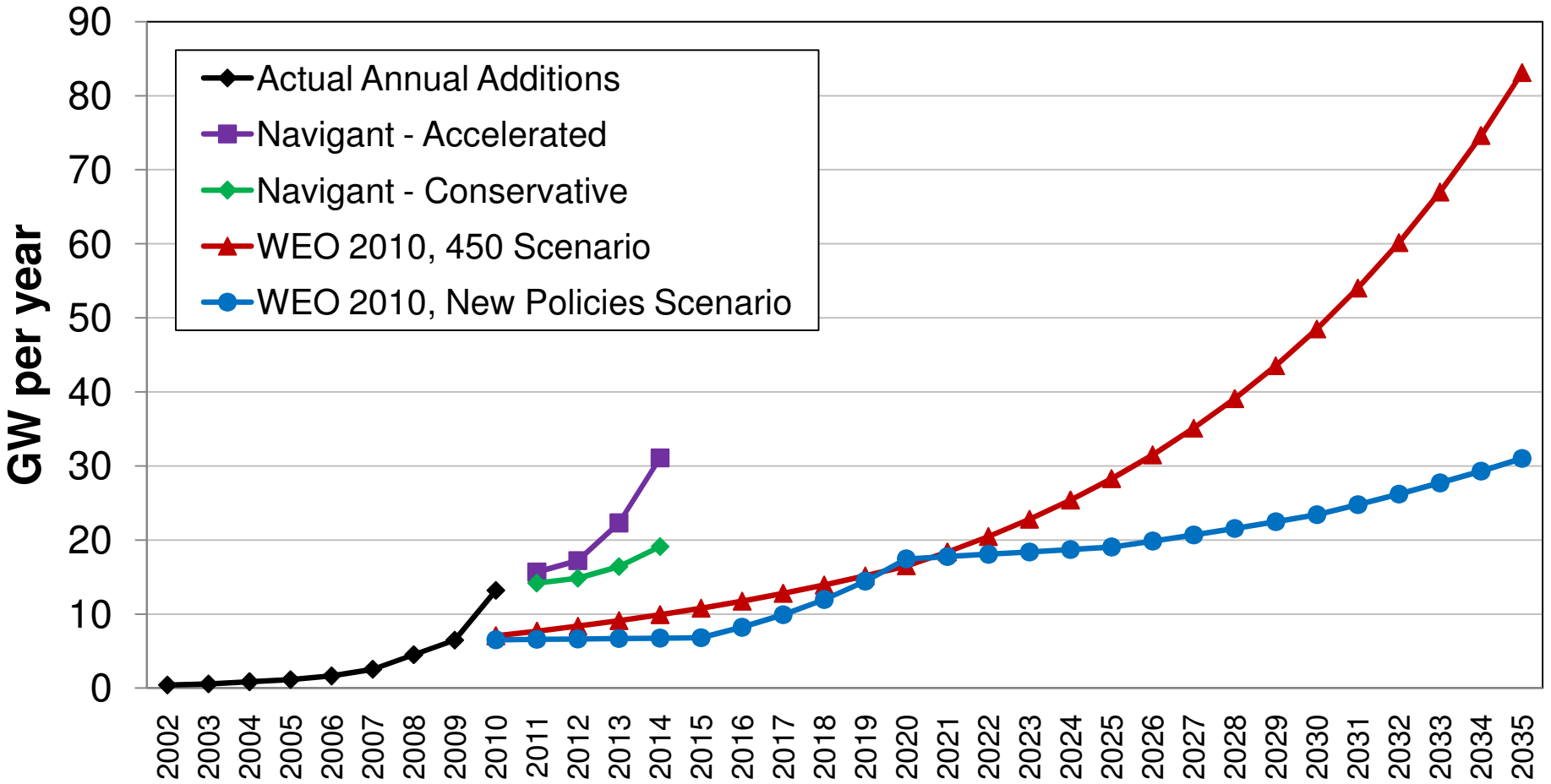
The WEO 2010 wind projections appear conservative, even for the 450 Scenario.



Notes:

- BTM Consult is a leading market research firm with a strong track record of accurate wind market forecasts.
- New Policies Scenario estimated from Figure 7.8
- 450 Scenario from Table 14.1

The WEO 2010 PV projections suggest markets will be below current levels at least through 2020.



Notes:

- Navigant data are corrected using a DC-AC conversion efficiency of 82%
- WEO 2010 New Policies Scenario estimated from Figure 7.8.
- WEO 2010 450 Scenario estimated from Table 14.1.

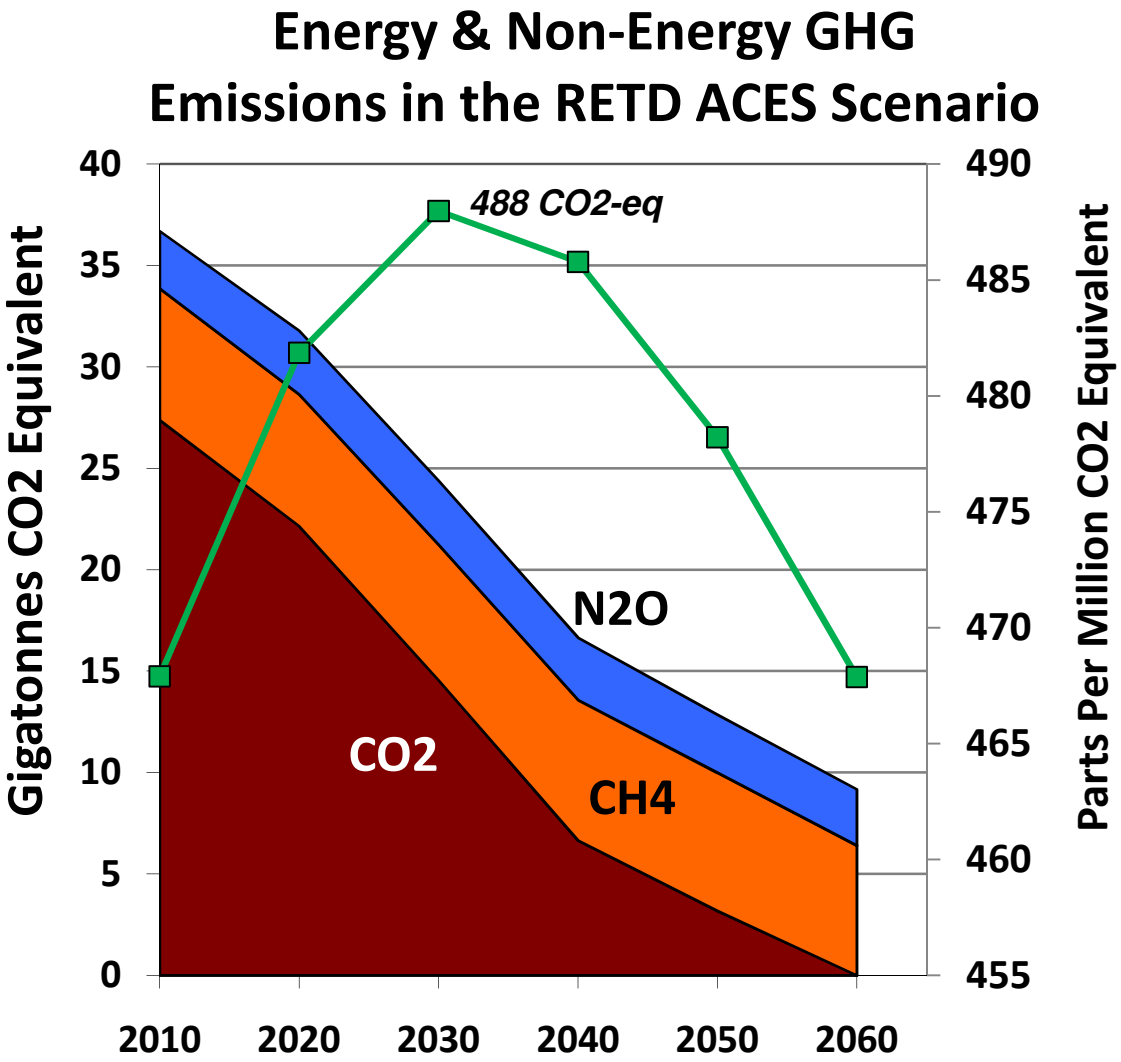
RETD and ETSAP have modeled a scenario driven by climate and security concerns.

RETD "ACES"[1] Scenario		
Drivers	**Scenario Description**	**Key Scenario Features**
Climate Change **Security**	• Climate change and security concerns align to drive decarbonisation and energy independence	• GHG targets that achieve climate stabilization with high probability: 400ppm CO_2-eq. • Constrained global trade in energy commodities, reflecting an insecure world and the desire for energy independence • Grid evolution moves quickly to support the rapid deployment of RE, EE and other low-carbon options

1. **A**chieving **C**limate and **E**nergy **S**ecurity.

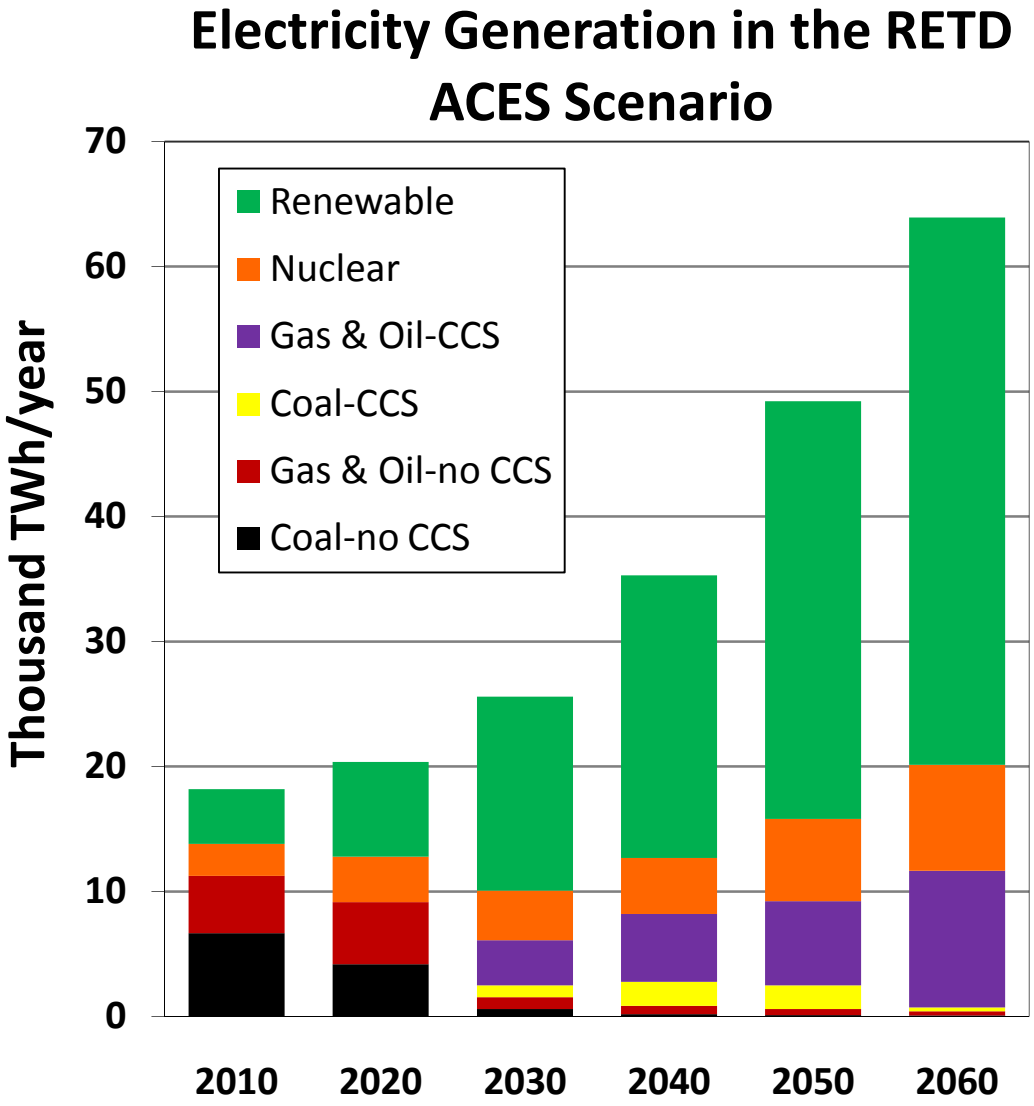
In the RETD ACES scenario, GHG concentrations peak around 2030.

- Entire system is CO_2 free by about 2060
  - Energy system CO_2 reductions (incl. Bio-CCS)
  - Decreased emissions from land use change
  - Reforestation
- CH_4 and N_2O emissions are consistent with aggressive, published scenarios

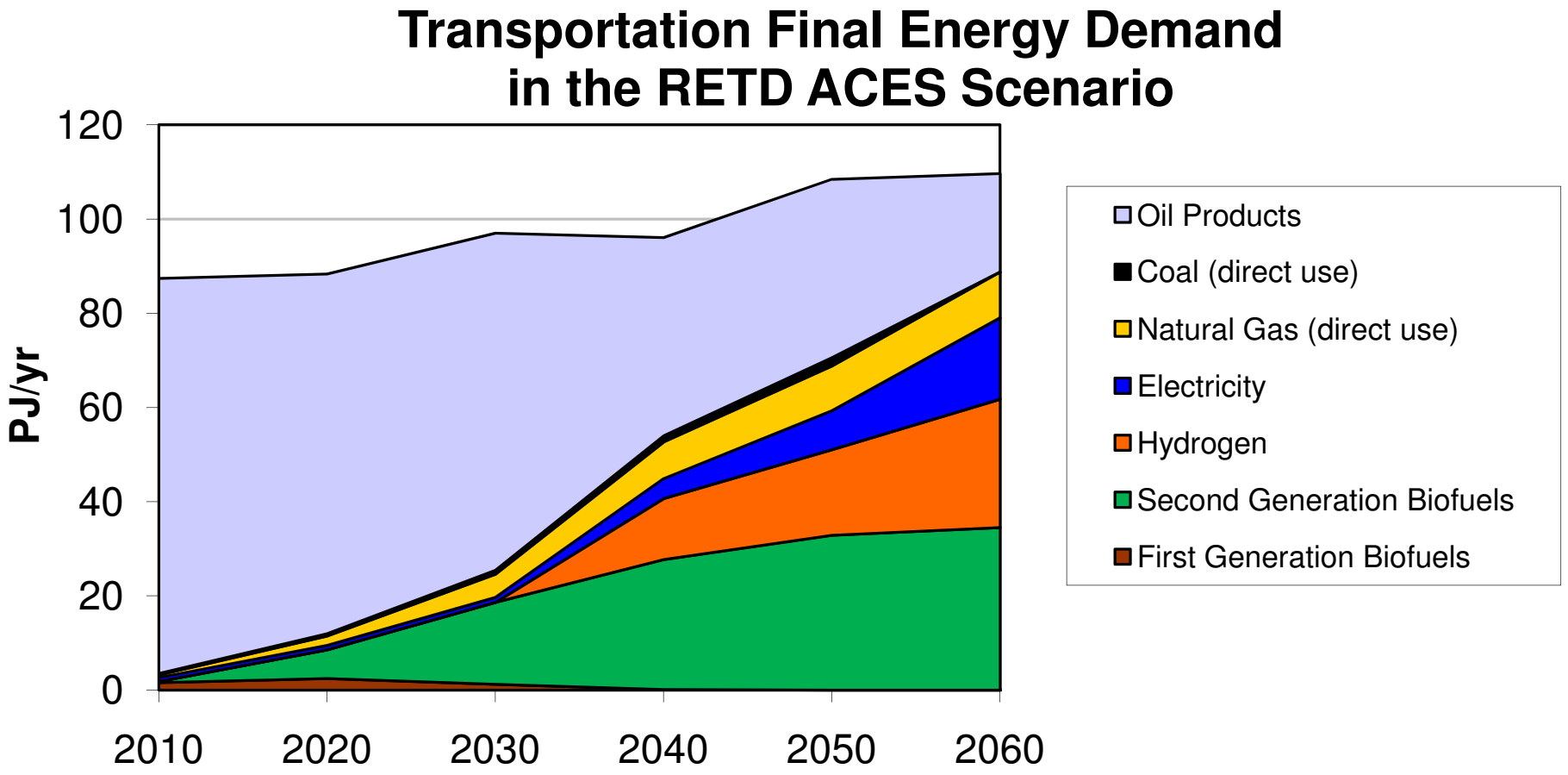


By 2060, RE produces 70% of all electricity.

- Electricity is virtually decarbonized by 2030.
  - CCS's technological uncertainty is a critical issue, given its role (incl. biomass-CCS).
- Rapid electricity decarbonization promotes increased share in buildings, industry and transport.



The transportation fuel mix changes more slowly, but petroleum use is cut >50% by 2050.



Rising efficiency helps keep total transport energy demand growth to a minimum.

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Achieving 400 ppm CO_2-eq is feasible but requires immediate and significant action.

- RE becomes the dominant energy source after 2030
- A strong shift to more electricity use is key, incl. transport
- Enabling technologies (e.g., Smart Grid, CCS) are critical
  - Uncertainty regarding them must be better understood.
- Biomass utilization is at the upper end of its technical potential
- Incremental net present value cost is less than 1% of cumulative global GDP through 2060.
- Models need additional improvements

Conclusions – Energy Modelling Economics

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The direct net costs of climate change mitigation are small to negative.

Incremental Investments and Savings over "Reference" Scenarios ($ trillion)				
Scenario	**Timeframe**	**Incremental Investments**	**Incremental Savings**	**Net Costs (Savings)**
WEO 2009 450	2010-2030	$10.5	$17.1	• ($6.6) undiscounted • ($0.45) at 10% disc. rate
WEO 2010 450	2010-2035	$18	Not provided	• Not provided
ETP 2010 Blue MAP	2010-2050	$46	$112	• ($66) undiscounted • ($8) at 10% disc. rate
RETD ACES	2010-2060	• $14 net costs at 5% discount rate		

Some points of comparison:

- Total annual global GDP: ~$60 trillion
- Total annual US military spending: ~$660 billion
- Estimated annual US environmental & health costs of fossil fuel use: $120-350 billion

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RETD is examining climate adaptation and fossil fuel dependence costs to complete the economic picture.

- Current global energy system models:
  - Underestimate RE benefits (and therefore the market)
  - Overestimate the net costs of GHG reductions
- Global economic models used to examine climate adaptation and damage costs oversimplify the modeling of the energy sector.
- RETD would therefore like to see “externalities” better incorporated into detailed energy system models.

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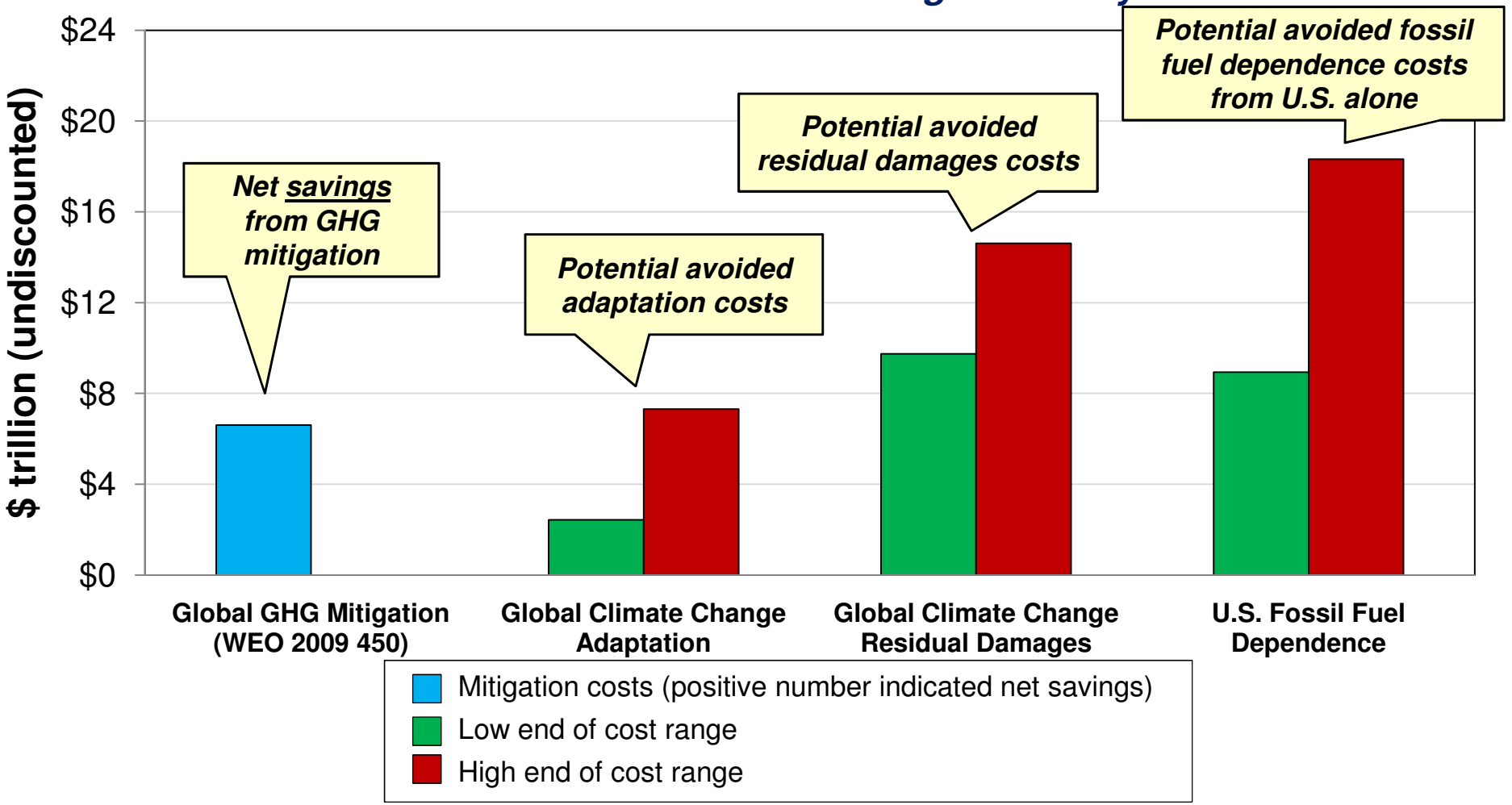
Climate change adaptation & damage, and fossil fuel dependence cover many elements.

Adaptation & Damage Costs	Fossil Fuel Dependence Costs
• Sectoral impacts (e.g., forestry, agriculture, tourism) • Water supply • Infrastructure hardening (coastal protection, energy) • Ecosystem impacts • Extreme weather events • Human health • Potential conflicts and human migration	• Wealth transfer • Above market prices (producers have market power) • Economic losses from price shocks • Price volatility • Military expenditures • Health & environmental impacts

The complete economic picture shows the cost of NOT modernizing the energy system is tremendous.

Indicative Costs and Benefits of GHG Mitigation: 20-year Estimates



- Mitigation costs include lifetime energy cost savings of investments made for 2010-2030.
- Adaptation costs are based on annual estimates for the 2030 timeframe but are likely significant underestimates.
- U.S. fossil fuel dependence costs are for military, non-climate environmental/health, and general macroeconomic costs.

There is still a lot to do on climate change adaptation.

- Different studies not easily compared
- Insufficient info leads to high uncertainty in estimates
- Disagreement on appropriate discount rates
- Often not quantified are:
  - Mining, manufacturing, retail, & tourism sectors
  - Catastrophic events (low-probability/high-impact)
  - Violent conflict and migration
  - Impacts beyond 2100
- Existing estimates may underestimate impacts by 2-8x.

Fossil fuel dependence cost estimates also have large gaps.

- Quantification of price volatility impacts
- Most studies cover only selected elements, regions, or countries
- Limited work on coal and natural gas dependence
  - Coal environmental and health impacts may exceed the market value of the coal produced.
- Actual oil price increases have exceeded those analyzed

Conclusions – Adaptation & Fossil Fuel Dependence

Analysis of the relative economics of scenarios must include a complete set of costs and benefits.

- Adaptation, damages and fossil fuel dependence costs are significant, underappreciated and underestimated.
  - Combined, they are likely on the order of $1 trillion/yr
- Mitigation investments can easily be “paid for” by reduced adaptation, damages and reduced fossil fuel dependence
- There is a lot more work to be done to fully quantify these costs and find a way to incorporate them into
  - Energy system modeling
  - Decision-making
  - Policy development

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There is a need to accelerate RE deployment.

- Despite the compelling opportunity, RE deployment is not happening fast enough.
- Numerous barriers are preventing more rapid RE deployment
- There is a need to do something significant in the near term (next 5 years) to dramatically accelerate RE deployment.
- **The RETD is developing such a strategy.**

THANK YOU

For additional information on the RETD

Online: www.iea-retd.org
Contact: IEA_RETD@ecofys.com

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Notice

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The RETD is comprised of ten countries: Canada, Denmark, France, Germany, Ireland, Italy, Japan, the Netherlands, Norway, and the United Kingdom. Hans Jørgen Koch, Deputy State Secretary, Ministry of Climate and Energy, Danish Energy Agency, serves as Chair of the RETD.

The RETD Implementing Agreement is one of a number of Implementing Agreements on renewable energy under the framework of the International Energy Agency (IEA). The creation of the RETD Implementing Agreement was announced at the International Renewable Energy Conference in Bonn, 2004.

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Historically, BTM forecasts have mostly underestimated actual wind capacity additions.