

GLIMPSE: An integrated assessment model-based tool for coordinated energy and environmental planning Dan Loughlin, Ph.D., Office of Research and Development

State Energy and Air Quality Group Webinar Series, June 8th, 2017

Office of Research and Development Air Pollution Prevention and Control Division, Atmospheric Protection Branch





• Objective of this presentation

- Introduce the GLIMPSE project and demonstrate its use
- The demo will walk through an application, giving a sense of both user-friendliness and capabilities

Intended audience

 State modelers and analysts interested in tools for facilitating longterm energy and air quality planning

Additional contributors

- EPA: Chris Nolte, Tai Wu, and Carol Lenox
- ORISE participants and fellows: Wenjing Shi, Yang Ou, Samaneh Babaee, and Troy Hottle

• Disclaimers

- While this material has been cleared for presentation, it does not necessarily reflect the views or policy of the U.S. EPA
- Results are provided for illustrative purposes only



Abbreviations

- Greenhouse gases
 - CO₂ carbon dioxide
 - CH_4^- methane
- Traditional air pollutants
 - NOx nitrogen oxides
 - SO₂ sulfur dioxide
 - CO carbon monoxide
 - PM particulate matter
 - PM_{2.5} PM with a diameter less than 2.5 microns
 - O₃ ozone
- Policies and regulations
 - CAFE Corporate Vehicle Efficiency Standard
 - CSAPR Cross-State Air Pollution Rule
 - RES Renewable Electricity Standard

- Modeling
 - IAM Integrated Assessment Model
 - GCAM Global Change Assessment Model
 - MOVES MObile Vehicle Emissions Simulator
 - IPM Integrated Planning Model
 - NONROAD Nonroad mobile source model
- Energy and technologies
 - EGU Electricity generating unit
 - NG natural gas
 - BEV battery electric vehicle
 - FCEV fuel cell electric vehicle
 - PV photovoltaic



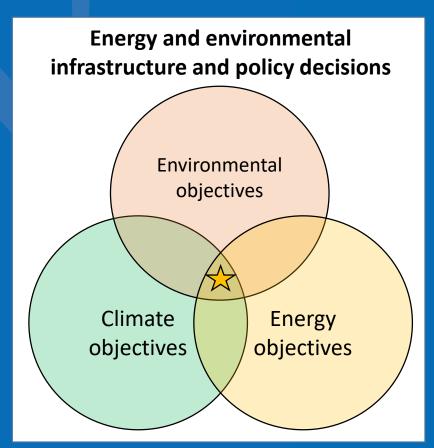


- GLIMPSE project objectives
- Background: GCAM and GCAM-USA
- GLIMPSE activities
- Demonstration
- Next steps



GLIMPSE project objectives

- Develop model-based tools for long-term environmental and energy planning
 - Evaluate scenarios (exploring assumptions: technology, policy, socioeconomic, ...)
 - Understand tradeoffs among policy options
 - Identify cost-effective, robust management strategies
- Support decisions at various geo-political scales
 - National
 - Regional
 - State
- Desired attributes
 - Low-cost or free, open source
 - Easy to use
 - Executes on desktop computer
 - Relatively quick



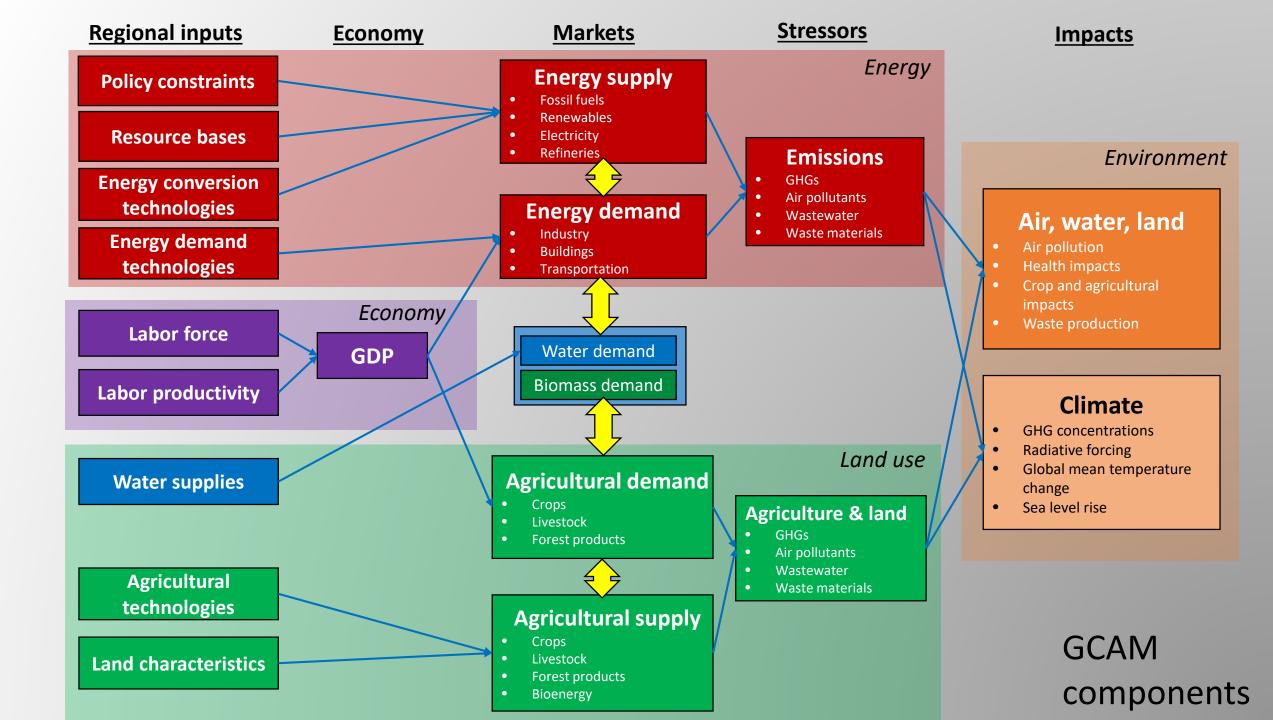


Background

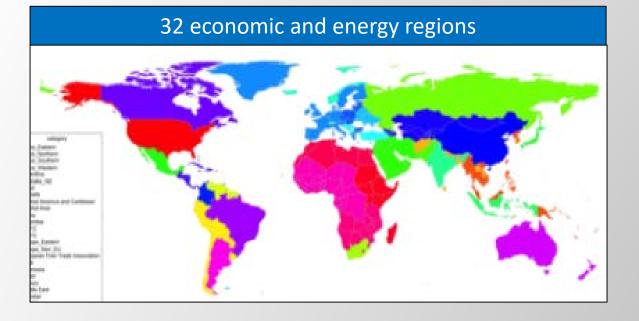
- Several years ago, we learned about PNNL's development of GCAMUSA, a state-level variant of the Global Change Assessment Model (GCAM)
- GCAM:
 - A technology-rich Integrated Assessment Model (IAM)
 - IAMs simulate interactions among human and earth systems
 - Major systems represented in GCAM:

Water Supply and demand	Economy Labor and productivity, GDP	Land use Agriculture: food, biomass	Energy system Electricity, industry, buildings, transportation	Environment Carbon cycle, atmospheric composition, temperature, air pollutant emissions
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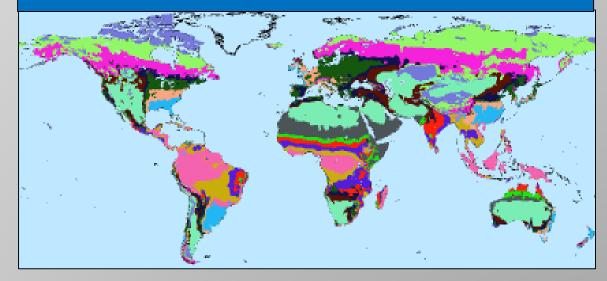
- 30 years of applications, predominantly related to climate change mitigation
- Estimates greenhouse gas (GHG) emissions, but also NOx, SO₂, CO, PM, NH₃ and other air pollutants
- Global coverage, 32 regions; Time horizon of 2010-2100 in 5 yr steps
- Public domain, open source, requires no proprietary software to run, free
- Runtime of <<1 hour on a typical desktop computer</p>



Temporal and spatial resolution



283 agriculture and land use regions



233 water basins



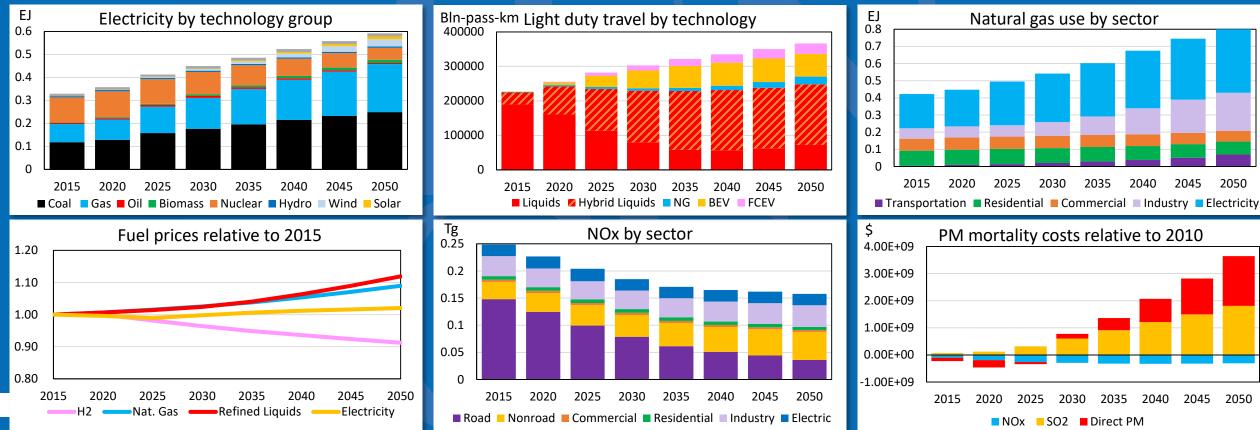
1990 to 2100 5-yr time steps



Background, cont'd

- GCAM-USA:
 - Shares the same code as GCAM
 - Energy system represented at the state level

Example state-level outputs for a scenario of the future (these are for Virginia):



2050

2050



Questions addressed by GCAM-USA

How would these outputs change if a state, region or the US ...

- incentivizes <u>vehicle electrification</u> or increases <u>CAFE</u> targets?
- adopts new <u>biofuel targets</u>?
- implements a new renewable electricity standard (RES)?
- sets a target <u>CO₂ reduction goal</u>?
- implements <u>energy efficiency</u> measures?
- Other things that could be examined include:
 - which technological pathways cost-effectively meet multi-pollutant goals
 - whether or not existing coal and nuclear plant lifetimes are extended
 - implications of wide-spread adoption of advanced technologies
 - effects of drastically lower costs for solar PV, wind, stationary battery storage, or electric vehicles.



GLIMPSE activities

Improvements to model

Regulatory representations

- CSAPR
- CAFE
- State-level RES

Emission factors from MOVES, IPM, NONROAD

Graphical interface

Developed "Scenario Builder" to facilitate running the model and managing results

Modifying existing output tools for visualizing and analyzing results

GCAM-USA

Applications

Effects of alternative population growth and migration patterns on energy and emissions

Health effects of alternative energy pathways

Technology assessment

Partnering with others

EPA program office beta-testers of graphical interface

Beginning collaboration with EPA Region 1 to explore regional application:

 pathways for meeting state-level air quality, energy and climate targets

Other activities

Model evaluation: Comparing national-, state-, and sector-level emission outputs with the NEI and EPA projections

Adding impact factors: PM mortality costs, O₃ damage to timber and crops, N deposition





Comparison of GCAM-USA emission outputs and EPA inventories

(a) NO_x (b) SO_2 (c) PM₂₅ total National n GCAM-USA total emissions Inventory total emissions

National totals by pollutant

GCAM-USA: Solid lines EPA inventories: Dots

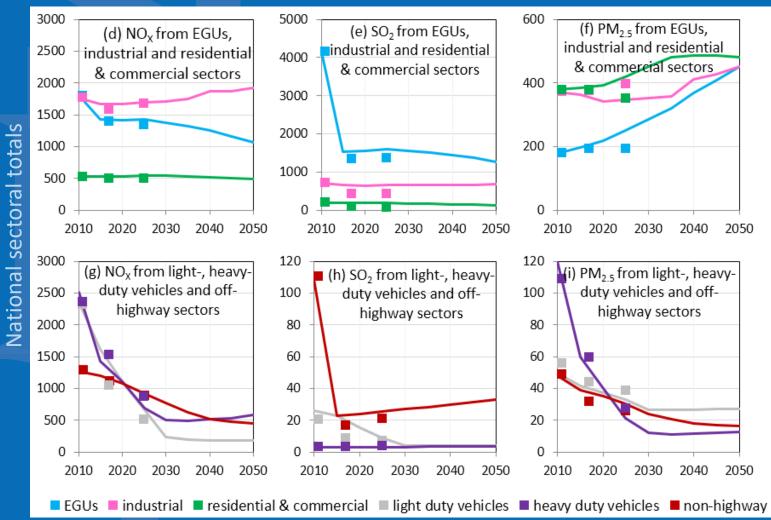




National totals by pollutant and sector

Comparison of GCAM-USA emission outputs and EPA inventories

GCAM-USA: Solid lines EPA inventories: Dots





Projecting emissions

2010 to 2050 emissions growth and control factors for NOx

GCAM-USA results can be processed to produce state-, pollutant-, source-category specific growth factors suitable for air quality modeling.

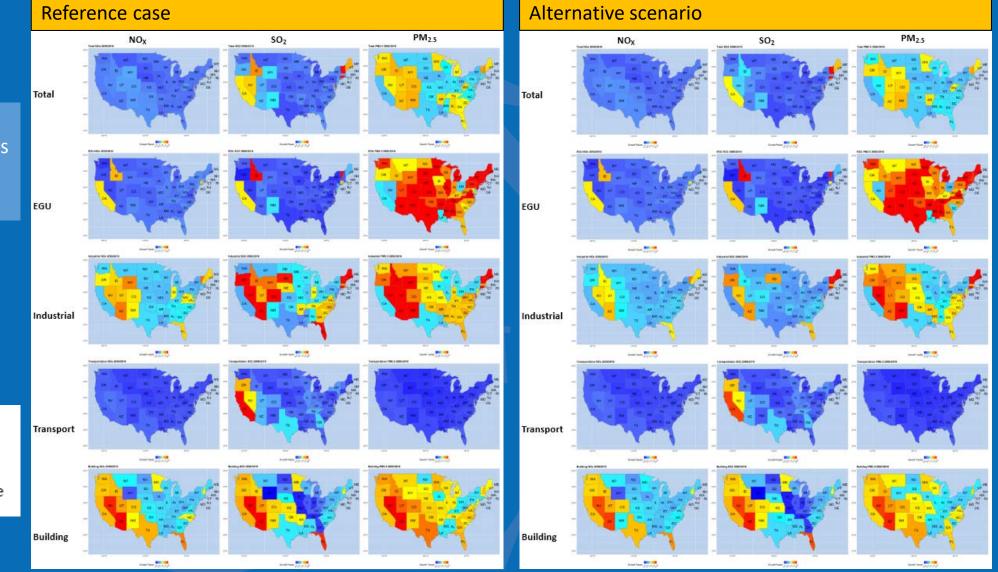
Here, we compare Reference Case factors with those of an alternative energy scenario.

		Reference Cas	е		Alternative scenario		
Sector	Fuel	СА	ОН	ТХ	СА	ОН	ТХ
Electric	Biomass	0.32	6.69	0.57	0.41	5.47	0.83
	Coal	0.20	0.43	0.33	0.17	0.35	0.32
	Gas	1.54	0.50	0.57	1.50	0.83	0.58
	Oil	1.33	1.15	1.03	1.13	0.83	1.00
Industrial	Coal	1.39	1.08	2.61	0.86	0.67	1.28
	Gas	1.15	0.83	1.61	1.04	0.81	1.42
	Oil	0.79	0.52	1.47	0.72	0.50	0.96
	Refineries	0.54	0.54	0.53	0.53	0.53	0.52
Commercial	Biomass	1.39	0.80	1.67	1.24	0.73	1.47
	Gas	1.44	0.70	1.44	1.39	0.69	1.38
	Oil	1.26	0.67	1.47	1.18	0.64	1.38
Residential	Gas	1.33	0.79	1.35	1.29	0.77	1.30
	Oil	1.61	0.88	1.73	1.54	0.85	1.64
	Wood	1.31	0.99	1.74	1.14	0.88	1.50
Mobile	LDV	0.06	0.04	0.06	0.06	0.04	0.06
	HDV	0.26	0.22	0.33	0.26	0.22	0.33
	Aircraft	1.31	0.63	1.37	1.28	0.62	1.34
	Marine & rail	1.03	0.22	0.60	0.93	0.21	0.65

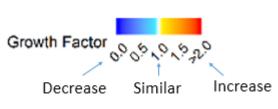


Projecting emissions

State-level 2010 to 2050 growth and control factors



Examining growth and control factors geographically provides some insights into state and regional trends.





Application: Renewable Electricity Standard (RES)

Hypothetical RES target - percent of electricity generated from new capacity added in that year, applied to each state in the US:

- 2020 30%
- 2030 40%
- 2040 50%
- 2050 60%



GLIMPSE Scenario Builder

GCAM ScenarioBuilder Candidate Scenario Components Construct or Edit Scenario filter: Name: RefUSA Scenario File Name Address Created Components: CAFE_extrapolated_fileLi... c:\projects\gcam-gui\data\gcam-usa\scenario... Wed Mar 29 10:44 building File Name CAFE fileList.txt c:\projects\gcam-gui\data\gcam-usa\scenario... Sat Feb 25 08:52: CAFE fileList.txt blocks CEthUSAReg 75BG.txt c:\projects\gcam-gui\data\gcam-usa\scenario... Sat Feb 18 09:50:1 Creating CSAPR_fileList.txt c:\projects\gcam-gui\data\gcam-usa\scenario... Wed Mar 01 13:0! CPP fileList.txt ElecTechBndCA.txt a scenario CSAPR_fileList.txt c:\projects\gcam-gui\data\gcam-usa\scenario... Sat Feb 25 08:52:1 NoNewNukeUSA.txt c:\projects\gcam-gui\data\gcam-usa\scenario... Mon Feb 13 18:27 ElecRESto100USA.txt c:\projects\gcam-gui\data\gcam-usa\scenario... Fri Feb 03 15:49:1 ElecRESto100USAB.txt Delete Create New Edit Analysis of results Working Scenarios filter: Analyze Run Name Components Run Date Complete RefUSA CAFE fileList.txt; CSAPR fileList.txt; ElecTechBndCA.txt; NoNew... Fri Mar 03 09:58:50 EST... true Run Selected RefUSANoPol REFUSA.txt; Fri Mar 03 09:58:50 EST... true RefUSAwNuke Delete Selected CAFE fileList.txt; CSAPR fileList.txt; ElecTechBndCA.txt; Fri Mar 03 09:58:50 EST... true Library of **One-click** RefUSANoPoIHE REFUSA.txt; HighEffBldgTechsUSA.txt; Fri Mar 03 09:58:50 EST... true Check Status scenarios scenario RefUSAwNukeHE CAFE fileList.txt; CSAPR fileList.txt; ElecTechBndCA.txt; HighEffB. Fri Mar 03 09:58:50 EST... true Empty Trash RefUSALowLDV CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew... execution Fri Mar 03 09:58:50 EST... true RefUSAHighLDV CAFE fileList.txt; CSAPR fileList.txt; ElecTechBndCA.txt; NoNew... Fri Mar 03 09:58:50 EST... true Options CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew... RESUSA Fri Mar 03 09:58:50 EST... true Help

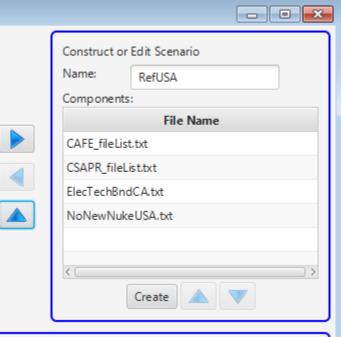


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Candidate Scenario Components filter:						
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Run Name	Components	Run Date	Complete	Analyze
RefUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Run Selected
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RefUSAwNuke	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt;	Fri Mar 03 09:58:50 EST	true	Delete Selected
RefUSANoPoIHE	REFUSA.txt; HighEffBldgTechsUSA.txt;	Fri Mar 03 09:58:50 EST	true	Check Status
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Component:		Values: Populate Delete Clear Applied to:			
Action:	Emission Cap (Mt)	Year Value world			
Sector:	System Wide				
Parameter:	NOx				
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Start Year:	2020	No content in table			
End Year:	2100				
Initial Amount:					
Growth (%):					
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New Scenario Component							
Preset Tech	Preset Tech Bound XML List						
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	Renewable Elec Std (%)						
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Туре:	initial w/% Growth 🔹						
Start Year:	2020	No content in table					
End Year:	2100						
Initial Amount	:						
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💵 New Scenario Component						
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Populate:						
Туре:	Initial w/% Growth					
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Initial Amount:						
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💷 New Scenario Component						
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💷 New Scenario Component						
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End Year:	2050					
Initial Amount:	30					
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New Scenario Component X Preset Tech Bound XML List Values: Populate Component: Delete Clear Applied to: Renewable Elec Std (%) Action: Ŧ Year Value world • Sector: 2020 30.00 USA Canada Parameter: 2025 35.00 EU-15 2030 40.00 Europe_Non_EU Populate: 2035 45.00 European Free Trade Association Initial and Final Type: Ŧ 2040 50.00 Japan 2020 Start Year: Australia_NZ 2045 55.00 2050 End Year: Central Asia 2050 60.00 Initial Amount: 30 Russia China Final Amount: 60 Middle East Africa_Eastern Africa Northern Add Save Close



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			2030	40.00	AK
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Candidate Scenario Com	iponents filter:		Construct or Edit Scenario
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SysTaxCO2Reg_NE20	c:\projects\gcam-gui\data\gcam-usa\scenario	Wed May 10 14:51:01	
TechBnd_CA_HFCV.txt	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:33:13	
TechBnd_CA_LDVCon	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 11:28:22	
TechBnd_CA_LDVEon	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:31:41	No content
TechBnd_USA_LDVEo	c:\projects\gcam-gui\data\gcam-usa\scenario	Fri Apr 28 08:04:38 E.	
ElecRES_USA_30-60	C:\Projects\GCAM-GUI\data\GCAM-USA\Scen	Wed May 17 08:21:42	
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RefUSAwNukeHE	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; HighEffB	Fri Mar 03 09:58:50 EST	true	Check Blattas
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RefUSAHighLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Options
RESUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	-

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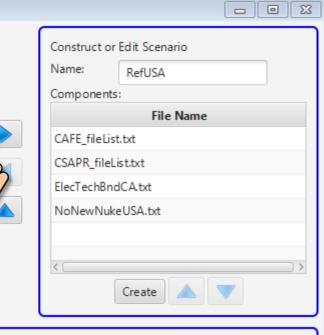
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File Name	Address	Created
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SysTaxCO2Reg_NE20	c:\projects\gcam-gui\data\gcam-usa\scenario	Wed May 10 14:51:01
TechBnd_CA_HFCV.txt	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:33:13
TechBnd_CA_LDVCon	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 11:28:22
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TechBnd_USA_LDVEo	c:\projects\gcam-gui\data\gcam-usa\scenario	Fri Apr 28 08:04:38 E.
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Run Name	Components	Run Date	Complete	Analyze
RefUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Mon May 01 16:26:06 E	true 🤶	Run Selected
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RefUSAwNuke	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt;	Fri Mar 03 09:58:50 EST	true 🗌	Delete Selected
RefUSANoPoIHE	REFUSA.txt; HighEffBldgTechsUSA.txt;	Fri Mar 03 09:58:50 EST	true	Check Status
RefUSAwNukeHE	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; HighEffB	Fri Mar 03 09:58:50 EST	true	Check Status
RefUSALowLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Empty Trash
RefUSAHighLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Options
RESUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	options
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Candidate Scenario Com	ponents filter:	
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TechBnd_USA_LDVEo	c:\projects\gcam-gui\data\gcam-usa\scenario	Fri Apr 28 08:04:38 E.
ElecRES_USA_30-60	C:\Projects\GCAM-GUI\data\GCAM-USA\Scen	Wed May 17 08:21:42
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New Edit Delete		



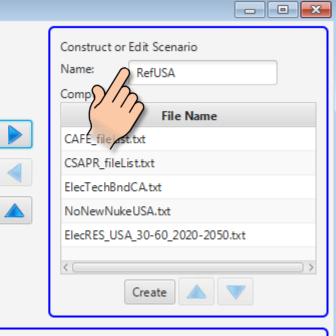
Run Name	Components	Run Date	Complete	Analyze
RefUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Mon May 01 16:26:06 E	true	Run Selected
RefUSANoPol	REFUSA.txt;	Fri Mar 03 09:58:50 EST	true	Kun Selected
RefUSAwNuke	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt;	Fri Mar 03 09:58:50 EST	true	Delete Selected
RefUSANoPoIHE	REFUSA.txt; HighEffBldgTechsUSA.txt;	Fri Mar 03 09:58:50 EST	true	Check Status
RefUSAwNukeHE	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; HighEffB	Fri Mar 03 09:58:50 EST	true	Check Status
RefUSALowLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Empty Trash
RefUSAHighLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Options
RESUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	- [



Edit Delete

New

Candidate Scenario Com	ponents filter:	
File Name	Address	Created
SysTaxCO2Reg2.txt	c:\projects\gcam-gui\data\gcam-usa\scenario	Mon Feb 13 18:28:02
SysTaxCO2Reg_NE20	c:\projects\gcam-gui\data\gcam-usa\scenario	Wed May 10 14:51:01
TechBnd_CA_HFCV.txt	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:33:13
TechBnd_CA_LDVCon	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 11:28:22
TechBnd_CA_LDVEon	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:31:41
TechBnd_USA_LDVEo	c:\projects\gcam-gui\data\gcam-usa\scenario	Fri Apr 28 08:04:38 E.
ElecRES_USA_30-60	$\label{eq:c:Projects} GCAM-GUI \ data \ GCAM-USA \ scen$	Wed May 17 08:21:42



Run Name	Components	Run Date	Complete	Analyze
RefUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Mon May 01 16:26:06 E	true î	Run Selected
RefUSANoPol	REFUSA.txt;	Fri Mar 03 09:58:50 EST	true	Kun Selected
RefUSAwNuke	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt;	Fri Mar 03 09:58:50 EST	true	Delete Selected
RefUSANoPoIHE	REFUSA.txt; HighEffBldgTechsUSA.txt;	Fri Mar 03 09:58:50 EST	true	Check Status
RefUSAwNukeHE	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; HighEffB	Fri Mar 03 09:58:50 EST	true	Check Status
RefUSALowLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Empty Trash
RefUSAHighLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Options
RESUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	



RESUSA

GCAM ScenarioBuilder					
Candidate Scenario Cor	nponents filte <i>r</i> :			nstruct or Edit Sc	
File Name	Address	Created		me: RESU:	SA
SysTaxCO2Reg2.txt	c:\projects\gcam-gui\data\gcam-usa\scenario	Mon Feb 13 18:28:		mponents:	ile Name
SysTaxCO2Reg_NE20	c:\projects\gcam-gui\data\gcam-usa\scenario	Wed May 10 14:51	.01	AFE_fileList.txt	
TechBnd_CA_HFCV.txt	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:33:1	12	SAPR fileList.txt	
TechBnd_CA_LDVCon	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 11:28:2	22	ecTechBndCA.txt	
TechBnd_CA_LDVEon	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:31:4	11	oNewNukeUSA.tx	t
TechBnd_USA_LDVEo	c:\projects\gcam-gui\data\gcam-usa\scenario	Fri Apr 28 08:04:38	E E	ecRES_USA_30-60	-
ElecRES_USA_30-60	C:\Projects\GCAM-GUI\data\GCAM-USA\Scen	Wed May 17 08:21		CCN25_05A_50-00	_2020-2050.000
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	filter:		>	Create	
			Run Date	Create	Analyze
Norking Scenarios Run Name	filter:	ndCA.txt; NoNew	Run Date Mon May 01 16:26:06 E	Complete	Analyze
Norking Scenarios Run Name RefUSA	filter: Components	ndCA.txt; NoNew		Complete	
Vorking Scenarios Run Name RefUSA RefUSANoPol	filter: Components CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBr		Mon May 01 16:26:06 E.	Complete true true	Analyze
Vorking Scenarios Run Name RefUSA RefUSANoPol RefUSAwNuke	filter: Components CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBr REFUSA.txt;		Mon May 01 16:26:06 E Fri Mar 03 09:58:50 EST	Complete true true true	Analyze Run Selected Delete Selected
Vorking Scenarios Run Name RefUSA RefUSANoPol RefUSAwNuke RefUSANoPolHE	filter: Components CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBr REFUSA.txt; CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBr	ndCA.txt;	Mon May 01 16:26:06 E Fri Mar 03 09:58:50 EST Fri Mar 03 09:58:50 EST	Complete true true true true true	Analyze Run Selected
Working Scenarios	filter: Components CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBr REFUSA.txt; CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBr REFUSA.txt; HighEffBldgTechsUSA.txt;	ndCA.txt; ndCA.txt; HighEffB	Mon May 01 16:26:06 E Fri Mar 03 09:58:50 EST Fri Mar 03 09:58:50 EST Fri Mar 03 09:58:50 EST	Complete true true true true true true	Analyze Run Selected Delete Selected

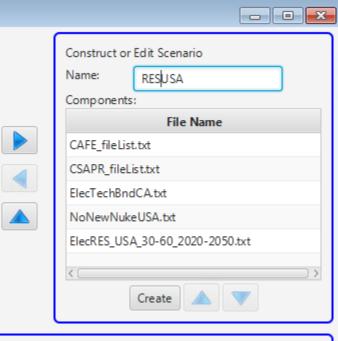
CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew... Fri Mar 03 09:58:50 EST... true

Help

5



Candidate Scenario Components filter:				
File Name	Address	Created		
SysTaxCO2Reg2.txt	c:\projects\gcam-gui\data\gcam-usa\scenario	Mon Feb 13 18:28:02		
SysTaxCO2Reg_NE20	c:\projects\gcam-gui\data\gcam-usa\scenario	Wed May 10 14:51:01		
TechBnd_CA_HFCV.txt	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:33:13		
TechBnd_CA_LDVCon	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 11:28:22		
TechBnd_CA_LDVEon	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:31:41		
TechBnd_USA_LDVEo	c:\projects\gcam-gui\data\gcam-usa\scenario	Fri Apr 28 08:04:38 E.		
ElecRES_USA_30-60	$\label{eq:c:Projects} C: \label{eq:cond} C: \label{cond} C: \label{eq:cond} C: c$	Wed May 17 08:21:42		
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New Edit Delete				

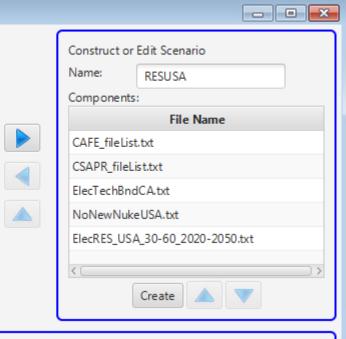


Working Scenarios	filter:			
Run Name	Components	Run Date	Complete	Analyze
RefUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Mon May 01 16:26:06 E	true	Run Selected
RefUSANoPol	REFUSA.txt;	Fri Mar 03 09:58:50 EST	true	Kun Selected
RefUSAwNuke	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt;	Fri Mar 03 09:58:50 EST	true 🗸	Delete Selected
RefUSANoPoIHE	REFUSA.txt; HighEffBldgTechsUSA.txt;	Fri Mar 03 09:58:50 EST	true	Check Status
RefUSAwNukeHE	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; HighEffB	Fri Mar 03 09:58:50 EST	true	Circex Status
RefUSALowLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Empty Trash
RefUSAHighLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Options
RESUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	cptions
1h			>``	Help



CAM ScenarioBuilder

Candidate Scenario Components filter:											
File Name	Address	Created									
SysTaxCO2Reg2.txt	c:\projects\gcam-gui\data\gcam-usa\scenario	Mon Feb 13 18:28:02									
SysTaxCO2Reg_NE20	c:\projects\gcam-gui\data\gcam-usa\scenario	Wed May 10 14:51:01									
TechBnd_CA_HFCV.txt	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:33:13									
TechBnd_CA_LDVCon	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 11:28:22									
TechBnd_CA_LDVEon	c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:31:41									
TechBnd_USA_LDVEo	c:\projects\gcam-gui\data\gcam-usa\scenario	Fri Apr 28 08:04:38 E.									
ElecRES_USA_30-60	C:\Projects\GCAM-GUI\data\GCAM-USA\Scen	Wed May 17 08:21:42									
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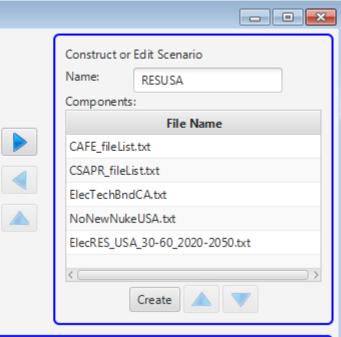
Run Name	Components	Run Date	Complete	Analyze
RefUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Mon May 01 16:26:06 E	true 🤶	Run Selected
RefUSANoPol	REFUSA.txt;	Fri Mar 03 09:58:50 EST	true	Kull Selected
RefUSAwNuke	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt;	Fri Mar 03 09:58:50 EST	true	Delete Selected
RefUSANoPoIHE	REFUSA.txt; HighEffBldgTechsUSA.txt;	Fri Mar 03 09:58:50 EST	true)	Check Status
RefUSAwNukeHE	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; HighEffB	Fri Mar 03 09:58:50 EST	true	Check Status
RefUSALowLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Empty Trash
RefUSAHighLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Options
RESUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	

nmental Protect v									
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CAM ScenarioBuilder

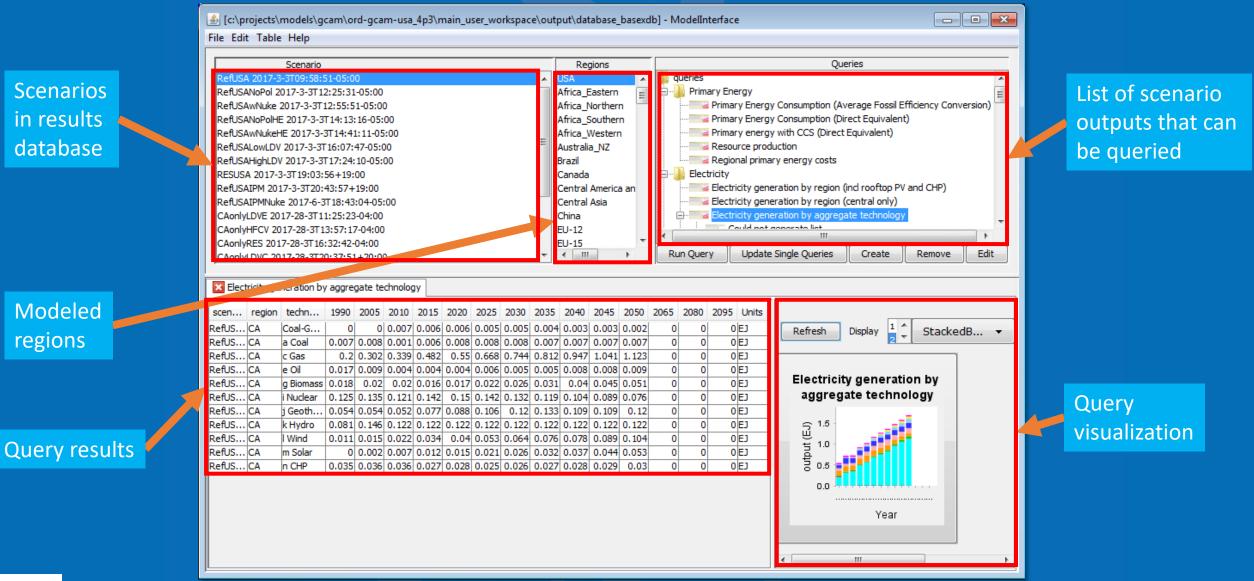
Address	Created
c:\projects\gcam-gui\data\gcam-usa\scenario	Mon Feb 13 18:28:02
c:\projects\gcam-gui\data\gcam-usa\scenario	
c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 11:28:22
c:\projects\gcam-gui\data\gcam-usa\scenario	Tue Mar 28 10:31:41
c:\projects\gcam-gui\data\gcam-usa\scenario	Fri Apr 28 08:04:38 E.
C:\Projects\GCAM-GUI\data\GCAM-USA\Scen	Wed May 17 08:21:42
	c:\projects\gcam-gui\data\gcam-usa\scenario c:\projects\gcam-gui\data\gcam-usa\scenario c:\projects\gcam-gui\data\gcam-usa\scenario



Run Name	Components	Run Date	Complete	Analyze
RefUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Mon May 01 16:26:06 E	true	Run Selected
RefUSANoPol	REFUSA.txt;	Fri Mar 03 09:58:50 EST	true	Null Selected
RefUSAwNuke	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt;	Fri Mar 03 09:58:50 EST	true	Delete Selected
RefUSANoPoIHE	REFUSA.txt; HighEffBldgTechsUSA.txt;	Fri Mar 03 09:58:50 EST	true	Check Status
RefUSAwNukeHE	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; HighEffB	Fri Mar 03 09:58:50 EST	true	
RefUSALowLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Empty Trash
RefUSAHighLDV	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	Options
RESUSA	CAFE_fileList.txt; CSAPR_fileList.txt; ElecTechBndCA.txt; NoNew	Fri Mar 03 09:58:50 EST	true	



GLIMPSE Enhanced ModelInterface



An extension of PNNL's ModelInterface

🔮 [c:\projects\models\gcam\ord-gcam-usa_4p3\main_user_workspace\output\database_basexdb] - ModelInterface



File Edit Table Help

on						
		Scenario		Regions		Queries
		RefUSA 2017-3-3T09:58:51-05:00		USA		🔰 queries 🔺
		RefUSANoPol 2017-3-3T12:25:31-05:00		Africa_Eastern		📄 🦣 Primary Energy 📰
		RefUSAwNuke 2017-3-3T12:55:51-05:00		Africa_Northern	-	Primary Energy Consumption (Average Fossil Efficiency Conversion)
		RefUSANoPolHE 2017-3-3T14:13:16-05:00		Africa_Southern		Primary Energy Consumption (Direct Equivalent)
		RefUSAwNukeHE 2017-3-3T14:41:11-05:00	=	Africa_Western		Primary energy with CCS (Direct Equivalent)
		RefUSALowLDV 2017-3-3T16:07:47-05:00		Australia_NZ		Resource production
		RefUSAHighLDV 2017-3-3T17:24:10-05:00		Brazil		Regional primary energy costs
	っ	RESUSA 2017-3-3T19:03:56+19:00		Canada		Electricity
\checkmark	Ь	RefUSAIPM 2017-3-3T20:43:57+19:00		Central America ar	n	Electricity generation by region (incl rooftop PV and CHP)
//	/	efUSAIPMNuke 2017-6-3T18:43:04-05:00		Central Asia		Electricity generation by region (central only)
		AonlyLDVE 2017-28-3T11:25:23-04:00		China		Electricity generation by aggregate technology
	/	CAonlyHFCV 2017-28-3T13:57:17-04:00		EU-12		Electricity constration by technology (inc color reafs)
	r	CAonlyRES 2017-28-3T16:32:42-04:00		EU-15	Ŧ	
		CAonlyLDVC 2017-28-3T20:37:51+20:00	-	4 III +		Run Query Update Single Queries Create Remove Edit

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Scenario		Regions	Queries
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RefUSAwNuke 2017-3-3T12:55:51-05:00		Africa_Northern	Primary Energy Consumption (Average Fossil Efficiency Conversion)
RefUSANoPolHE 2017-3-3T14:13:16-05:00		Africa_Sout	
RefUSAwNukeHE 2017-3-3T14:41:11-05:00	E	Africa_Wes	
RefUSALowLDV 2017-3-3T16:07:47-05:00		Australia_1	
RefUSAHighLDV 2017-3-3T17:24:10-05:00		Brazil	Regional primary energy costs
RESUSA 2017-3-3T19:03:56+19:00		Canada	🚊 📲 Electricity
RefUSAIPM 2017-3-3T20:43:57+19:00		Central America an	
RefUSAIPMNuke 2017-6-3T18:43:04-05:00		Central Asia	Electricity generation by region (central only)
CAonlyLDVE 2017-28-3T11:25:23-04:00		China	Electricity generation by aggregate technology
CAonlyHFCV 2017-28-3T13:57:17-04:00		EU-12	Electricity conception by technology (inc color reafs)
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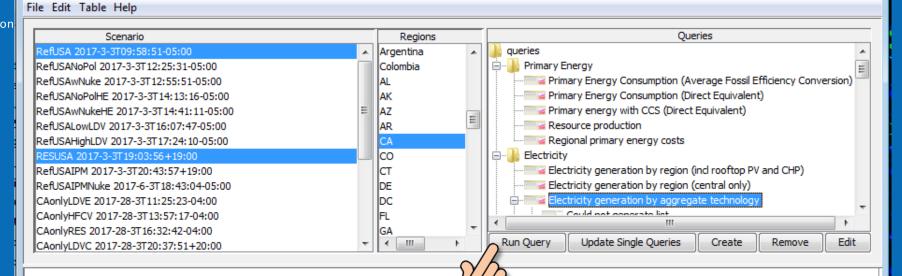
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RefUSAwNukeHE 2017-3-3T14:41:11-05:00	=	AZ	Primary energy with CCS (Direct Equivalent)	
RefUSALowLDV 2017-3-3T16:07:47-05:00		AR E	Resource production	
RefUSAHighLDV 2017-3-3T17:24:10-05:00		CA	Regional primary energy costs	
RESUSA 2017-3-3T19:03:56+19:00		со	🚊 🕛 Electricity	
RefUSAIPM 2017-3-3T20:43:57+19:00		ст	Electricity generation by region (incl rooftop PV and CHP)	
RefUSAIPMNuke 2017-6-3T18:43:04-05:00		DE	Electricity generation by region (central only)	
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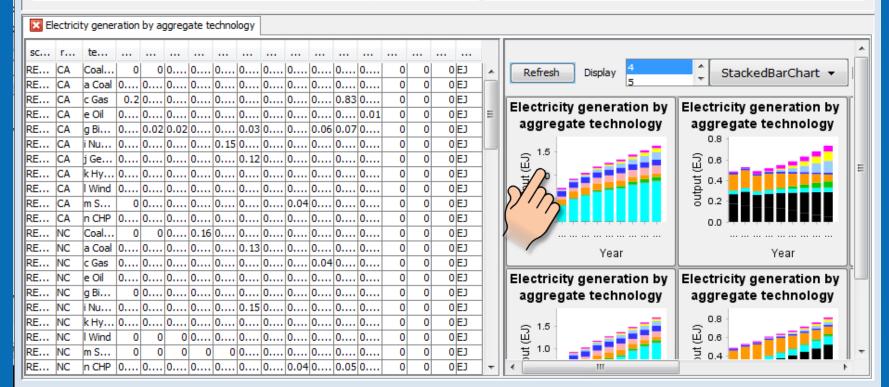
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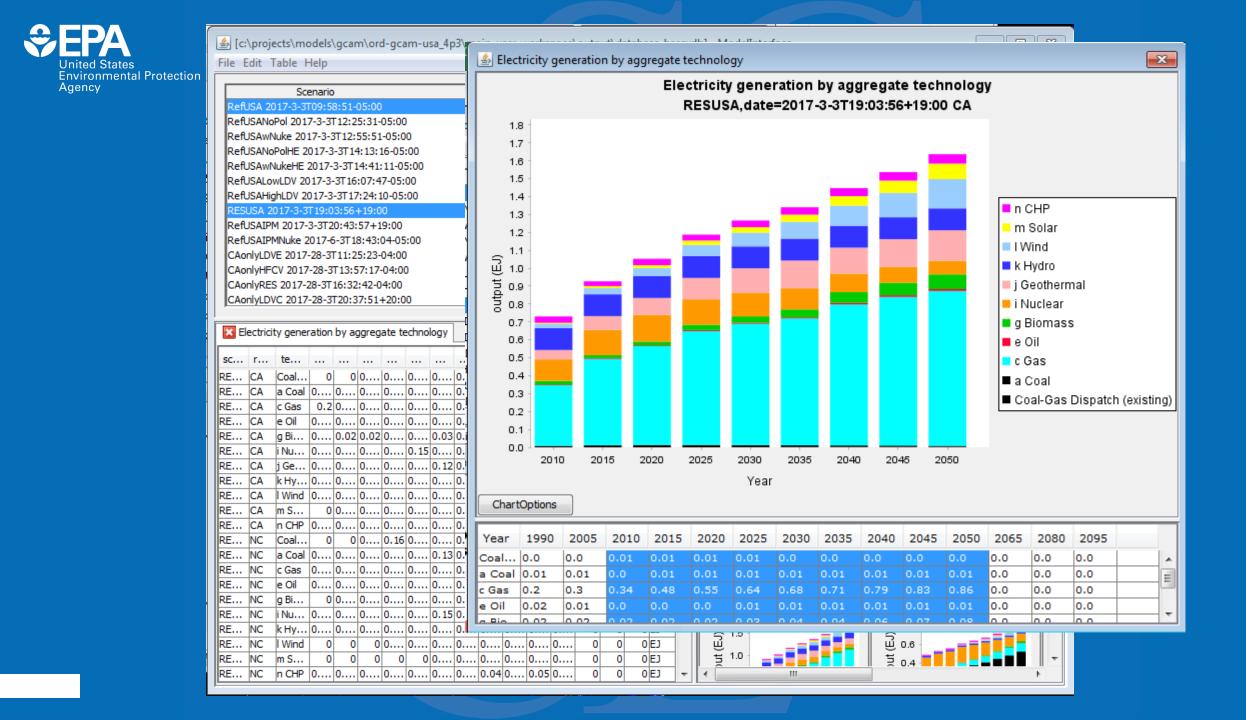
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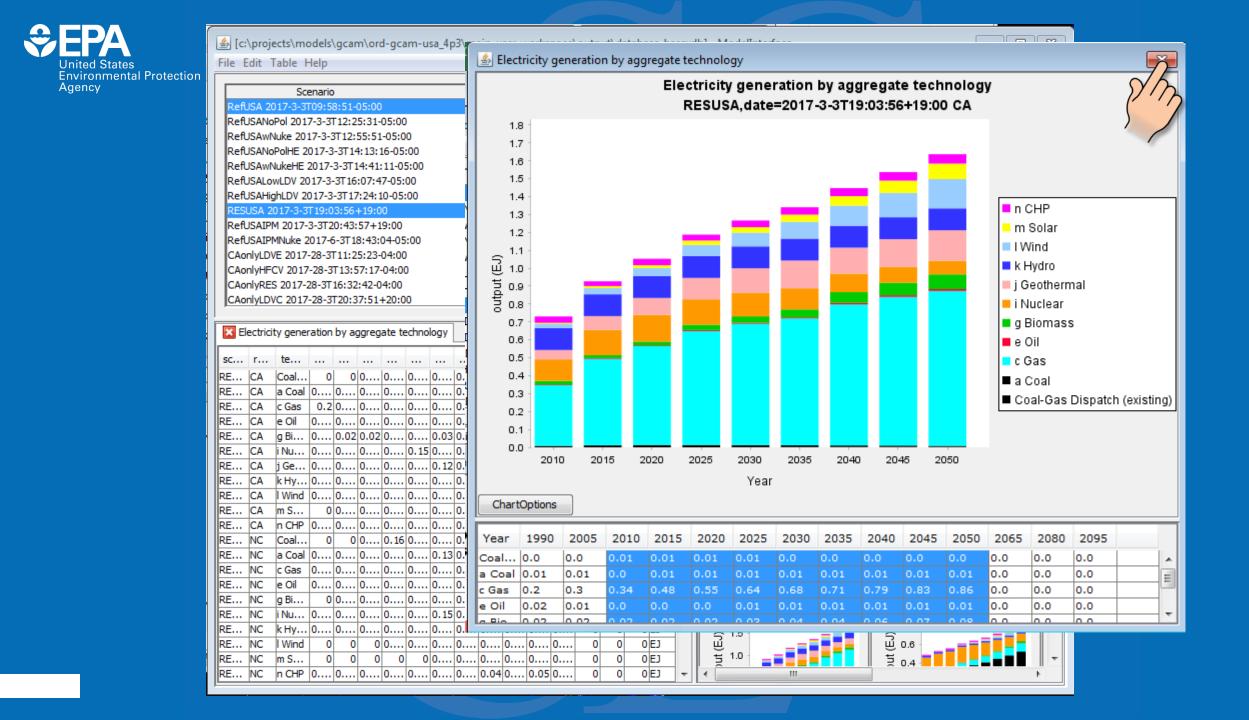


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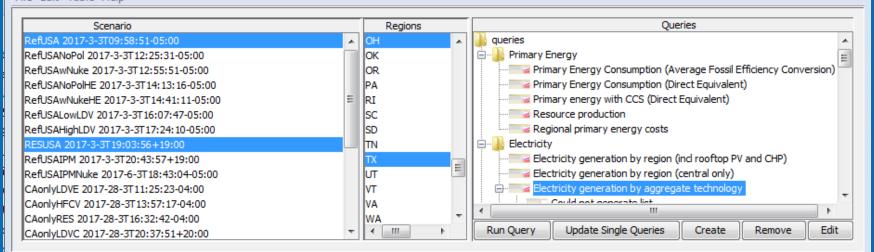


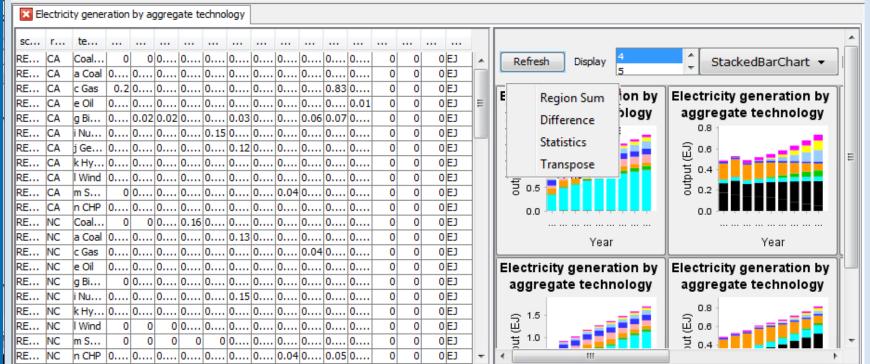
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Environmental Protection Agency

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Electricity generation by aggregate technology **Environmental Protection** Agency

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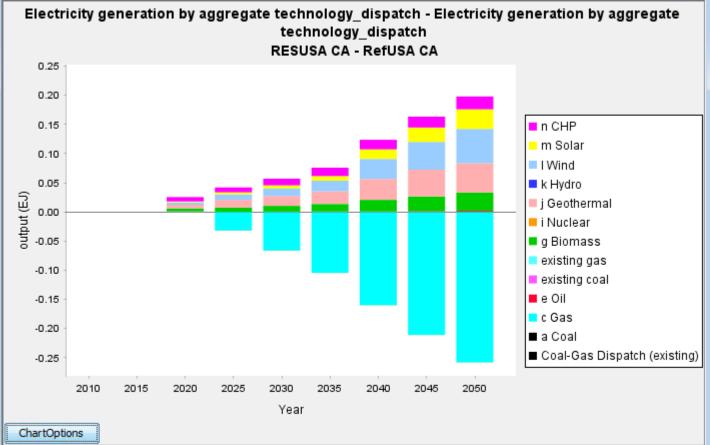
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Electricity generation by aggregate technology



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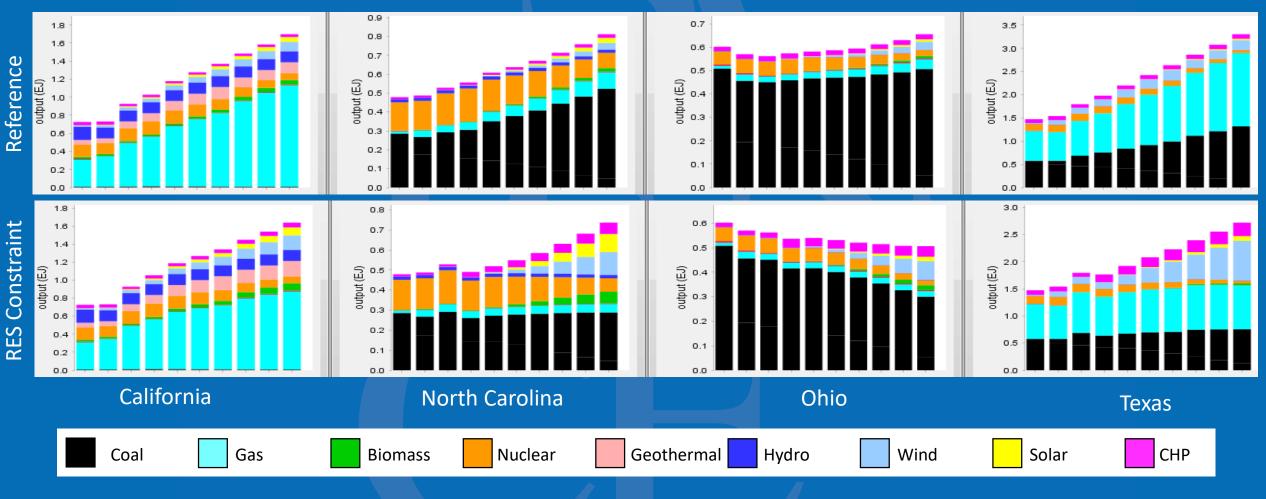
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Application: Renewable Electricity Standard

State-level electricity production (2005-2050) by aggregated technology





Application: Renewable Electricity Standard

Relative to reference case value in that year

			2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Chan	te in	California	0%	0%	0%	1%	1%	0%	0%	0%	-1%	-1%
CO, (0%	-3%	-6%	-6%	-7%	-7%	-7%	-8%		
202	Increased PN	M mortality relativ	/e to		0%	-3%	-3%	-5%	-7%	-9%	-12%	-15%
	reference la	rgely from:			0%	-3%	-5%	-6%	-8%	-10%	-12%	-13%
	 Increased 	biomass for elec	tricity									
	Other factor	·C •			2015	2020	2025	2030	2035	2040	2045	2050
Char		s. Fuel switching in res	nonso ta		0%	6%	7%	7%	8%	8%	7%	7%
Char elect		and natural gas price	•		0%	10%	15%	15%	15%	14%	14%	14%
elect		ease in utilization o	•	-	0%	9%	8%	7%	6%	5%	5%	4%
		products for electr			0%	12%	15%	16%	17%	17%	18%	18%
	production	•	lercy									
L					2015	2020	2025	2030	2035	2040	2045	2050
Chan	ge in	California	0%	0%	0%	2%	3%	5%	6%	7%	8%	9%
PM m	ortality	North Carolina	0%	0%	1%	1%	3%	4%	6%	7%	6%	
costs		Ohio	0%	0%	3%	4%	3%	2%	0%	-3%	-6%	
		Texas	0%	0%	0%	-4%	-5%	-7%	-9%	-11%	-13%	-15%



Application: Renewable Electricity Standard

				Relat	tive to r	Support	ing state	e-level d	ecision r	making:		
			2005	2010	2015						45	2050
Chan	ge in	California	0%	0%	0%	Results l	ike thes	e help ir	nform th	e proce	ss ^{1%}	-1%
CO ₂					0%	and poir		-		•	70/	-8%
2.	Increased P	M mortality relativ	ve to		0%				190000		2%	-15%
	reference la	argely from:			0%	• Is the	amount	of bioma	ass increa	ise	2%	-13%
	• Increase	d biomass for elec	tricity				ited prac					
			-		2015	Are th	nere mea	sures in	place or t	that could	d 45	2050
	Other facto	rs:			0%	be taken to avoid this PM health						7%
Char		fuel switching in res	•	se to disbenefit?							7% 4%	14%
elect	-	and natural gas price	-	-	0%				voided if t	5%	4%	
		rease in utilization o			0%	were	structure	ed differe	ently?		3%	18%
	•	n products for electr	icity		07					-,,,,	7/0	1070
	productio	n										
L					2015	2020	2025	2030	2035	2040	2045	2050
Chan	ge in	California	0%	0%	0%	2%	3%	5%	6%	7%	8%	9%
PM n	nortality	North Carolina	0%	0%	0%	1%	1%	3%	4%	6%	7%	6%
costs		Ohio	0%	0%	0%	3%	4%	3%	2%	0%	-3%	-6%
		Texas	0%	0%	0%	-4%	-5%	-7%	-9%	-11%	-13%	-15%



Next steps

- Continue to foster existing partner relationships
 EPA Program Offices and Region 1
- Seek out additional partners
 - beta testers for the model and GUI?
 - analyses with EPA regions and states?
- Explore other uses
 - classroom setting, university research projects?
- Applications
 - emission projections, technology assessment, population growth and migration patterns...?
- New GCAM-USA features
 - PNNL: industrial sector improvements, time slices (seasonal day and night)
 - ORD: air pollutant controls from CoST?

Questions?

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