

Appendix

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Appendix

Energy Literacy Questions

Energy Literacy/Knowledge Quiz

1. **Electrical energy units (kWh):** The amount of ELECTRICAL ENERGY (ELECTRICITY) we use is measured in units called...

- Kilowatt (kW)
- Kilowatt-hours (kWh)
- British Thermal Units (BTU)
- Volts (V)
- Horsepower (HP)

2. **Energy consumed and appliance power rating:** The amount of ENERGY consumed by an electrical appliance is equal to the power rating of the appliance (watts or kilowatts)...

- Multiplied by the cost of electricity
- Added to the cost of electricity
- Multiplied by the time it's used
- Divided by the time it's used
- Added to the time it's used

3. **Incandescent lightbulb conversion:** When you turn on an incandescent light bulb, which of the following energy conversion takes place?

- Electrical energy to radiant energy (light)

- Chemical energy to radiant energy (light)
- Electrical energy to radiant energy (light) and thermal energy (heat)
- Chemical energy to radiant energy (light) and thermal energy (heat)
- Electrical energy to radiant energy (light) and mechanical energy

4. Reason to buy energy star appliances: The best reason to buy an ENERGY STAR® appliance is...

- ENERGY STAR appliances are usually bigger
- ENERGY STAR appliances cost more
- ENERGY STAR appliances use less energy
- ENERGY STAR appliances are more modern looking
- ENERGY STAR appliances cost less

5. Which appliances uses the most energy: Which uses the MOST ENERGY in the average American home in one year?

- Refrigerating food and beverages
- Washing and drying clothing
- Heating and cooling rooms
- Heating and cooling water
- Lighting the home

6. Which appliance uses the most electricity: Which of the following items uses the MOST ELECTRICITY in the average home in one year?

- Lights

Refrigerator

Telephone

Television

Computer

7. **Which source provides most electricity in the US:** Which of the following sources provides most of the ELECTRICITY in the United States?

Nuclear power

Burning petroleum

Burning coal

Solar energy

Water (hydro) power

8. **Problem with electric cars:** Some people think that if we run out of fossil fuels we can just switch over to electric cars. What is wrong with this idea?

Most electricity is currently produced from fossil fuels (coal, oil, natural gas)

Switching to electric cars will make unemployment rates go up

It has been proven that it is impossible to build electric cars in great quantities

You can't use electricity to operate a car

There is nothing wrong with this idea

DeWaters, J. E., & Powers, S. E. (2011). Energy literacy of secondary students in New York State (USA): A measure of knowledge, affect, and behavior. *Energy Policy*, 39(3), 1699–1710.
<https://doi.org/10.1016/j.enpol.2010.12.049>

Experiment 1 - Energy Planning Task

State averages of consumption

Texas	Texas	California	California	Colorado	Colorado	Mass.	Mass.
Source average	Family	average	Family	average	Family	average	Family
Cooling	4,249	1,289		498		322	
Heating	5,099	5,597		16,411		19,108	
Water	4,396	4,601		5,832		5,070	
heat-							
ing							
Refrigerator	1,318	1,055		1,142		1,025	
Other	7,883	6,916		6,652		6,682	
Total	22,945	19,458		30,535		32,207	

Example 1 of task given to participants - reference class is USD. - Massachusetts Family

The Davis family wants to reduce its household electricity bill by \$1,042 next year. Please complete two possible action plans that will help the Davis family achieve this goal. Please enter how many kWh should be used next year by each appliance and the total kWh each plan would use. Enter only whole numbers. Try to provide close estimations. You may use a calculator to complete the task.

Note: The Davis family used 14,086 more kWh than the average household in Massachusetts last year.

Category	Electricity Used Last Year by the Davis Family (kWh)	Average Electricity Used Last Year by Households in Massachusetts (kWh)	Action Plan 1	Action Plan 2
Cooling	419	322		
(Central A/C)				
Heating	26,751	19,108		
the Home				
Water	10,543	5,070		
Heating				
Refrigeration	1,025			

Electricity Used Last Year Category by the Davis Family (kWh)	Average Electricity Used Last Year by Households in Massachusetts (kWh)	Action Plan 1	Action Plan 2
Other 7,350	6,682		
(Tele-			
vi-			
sion,			
Light-			
ing,			
Elec-			
tron-			
ics,			
Washer/Dryer,			
etc.)			
Total 46,293	32,207		
kWh			

Example 2 - reference class is kWh - Colorado Family

The Wells family wants to reduce its household electricity use by 5,965 kWh next year. Please complete two possible action plans that will help the Wells family achieve this goal. Please enter how many kWh should be used next year by each appliance and the total kWh each plan would use. Enter only whole numbers. Try to provide close estimations. You may use a calculator to complete the task.

Note: The Wells family used 9,233 more kWh than the average household in Colorado last year.

Category	Electricity Used Last Year by the Wells Family (kWh)	Average Electricity Used Last Year by Households in Colorado (kWh)	Action Plan 1	Action Plan 2
Cooling	697	498		
(Central A/C)				
Heating	18,052	16,411		
the Home				
Water	11,667	5,832		
Heating				
Refrigeration	1,570	1,142		

Category	Electricity Used Last Year by the Wells Family (kWh)	Average Electricity Used Last Year by Households in Colorado (kWh)	Action Plan 1	Action Plan 2
Other	7,882	6,652		
(Television,				
Lighting,				
Electronics,				
Washer/Dryer,				
etc.)				
Total	39,768	30,535		
kWh				

Example 3 - reference class is percentage - Texas Family

The Smith family wants to reduce its household electricity use by 15% next year. Please complete two possible action plans that will help the Smith family achieve this goal. Please enter how many kWh should be used next year by each appliance category and the total kWh each plan would use. Enter only whole numbers. Try to provide close estimations. You may use a calculator to complete the task.

Note: The Smith family used 6,101 more kWh than the average household in Texas last year.

Electricity Used Last Year by Category	Average Electricity Used Last Year by Households in Texas (kWh)	Action Plan 1	Action Plan 2
Cooling	6,573	4,249	
(Central A/C)			
Heating	6,118	5,099	
the Home			
Water	5,257	4,396	
Heating			
Refrigeration	639	1,318	

Category	Electricity Used Last Year by the Smith Family (kWh)	Average Electricity Used Last Year by Households in Texas (kWh)	Action Plan 1	Action Plan 2
Other	8,459	7,883		
(Tele-				
vi-				
sion,				
Light-				
ing,				
Elec-				
tron-				
ics,				
Washer/Dryer,				
etc.)				
Total	29,046	22,945		
kWh				

Example 4 - California Family

The Adams Family

Electricity Used Last Year Category	Average Electricity Used Last Year by Households in California (kWh)	Action Plan 1	Action Plan 2
Cooling by the Adams Family (kWh)	1,289		
(Central A/C)			
Heating	5,597		
the Home			
Water	4,601		
Heating			
Refrigeration	1,055		

Category	Electricity Used Last Year by the Adams Family (kWh)	Average Electricity Used Last Year by Households in California (kWh)	Action 1	Action 2
Other	7,608	6,916		
(Television,				
Lighting,				
Electronics,				
Washer/Dryer,				
etc.)				
Total	22,673	19,458		
kWh				

Breakdown of the states given to participants

Texas	Texas	California	California	Colorado	Colorado	Mass.	Mass.
Source average	Family	average	Family	average	Family	average	Family
Cooling	4,249	6,573	1,289	2,581	498	697	322
Heating	5,099	6,118	5,597	6,157	16,411	18,052	26,751

	Texas	Texas	California	California	Colorado	Colorado	Mass.	Mass.
Source average	Family	average	Family	average	Family	average	Family	
Water	4,396	5,257	4,601	5,061	5,832	11,667	5,070	10,543
heat-								
ing								
Refrigerator	3,108	2,639	1,055	1,266	1,142	1,370	1,025	1,230
Other	7,883	8,459	6,916	7,608	6,652	7,982	6,682	7,350
Total	22,945	29,046	19,458	22,673	30,535	39,768	32,207	46,293

Experiment 2 - Energy Planning Task

Task amounts: 15% vs. 10% exact

							10%
State/Reference	15% kWh	10% kWh	15% USD	10% USD	15% Percent	Percent	
Adams / Cali	3,401	2,267	\$510	\$340	15%	10%	
Smith / Texas	4,357	2,905	\$479	\$320	15%	10%	
Wells / Colorado	5,965	3,977	\$656	\$438	15%	10%	
Davis / Mass	6,944	4,629	\$1,042	\$694	15%	10%	

Task amounts: 15% vs. 10% rounded

State/Reference	15% kWh	10% kWh	15% USD	10% USD	15% Percent	10% Percent
Adams / Cali	3,450	2,300	\$518	\$345	15%	10%
Smith / Texas	4,350	2,900	\$479	\$319	15%	10%
Wells / Colorado	6,000	4,000	\$660	\$440	15%	10%
Davis / Mass	6,900	4,600	\$1,035	\$690	15%	10%

Adams Family / Cali (\$0.15 per kWh) (diff: 3,542)

Source	State average	Exact	Rounded
Cooling	1,289	2,581	3,000
Heating	5,597	6,157	6,000
Water heating	4,601	5,061	5,000
Refrigerator	1,055	1,266	1,000
Other	6,916	7,608	8,000
Total	19,458	22,673	23,000

Smith Family / Texas (\$0.11 per kWh) (diff: 0,055)

Source	State average	Exact	Rounded
Cooling	4,249	6,573	7,000
Heating	5,099	6,118	6,000
Water heating	4,396	5,257	5,000
Refrigerator	1,318	2,639	3,000
Other	7,883	8,459	8,000
Total	22,945	29,046	29,000

Wells Family / Colorado (\$0.11 per kWh) (diff: 3,405)

Source	State average	Exact	Rounded
Cooling	498	697	1,000
Heating	16,411	18,052	18,000
Water heating	5,832	11,667	12,000
Refrigerator	1,142	1,370	1,000
Other	6,652	7,982	8,000
Total	30,535	39,768	40,000

Davis Family / Massachusetts (\$0.15 per kWh) (diff: 13,133)

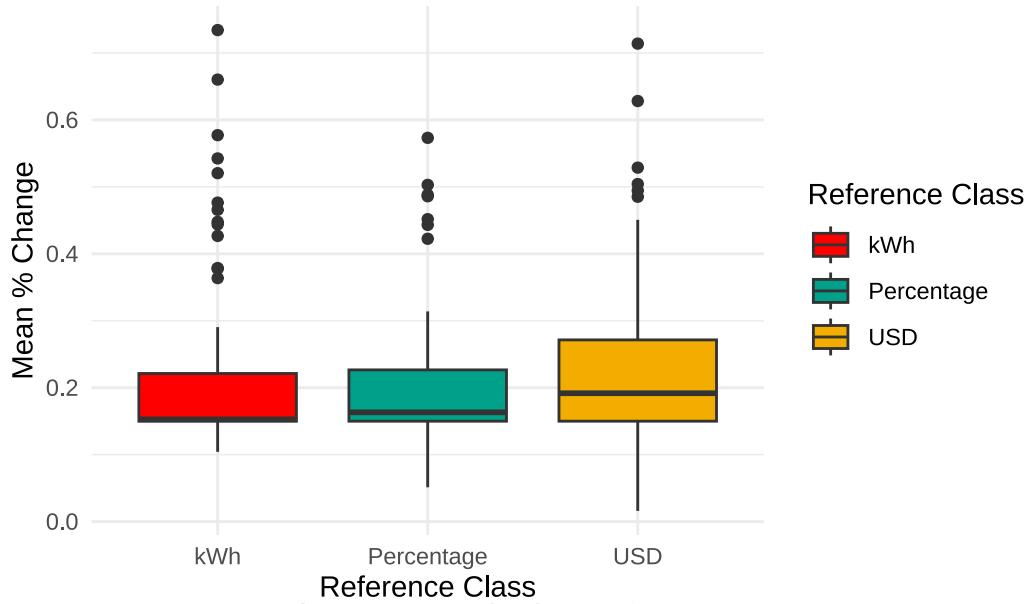
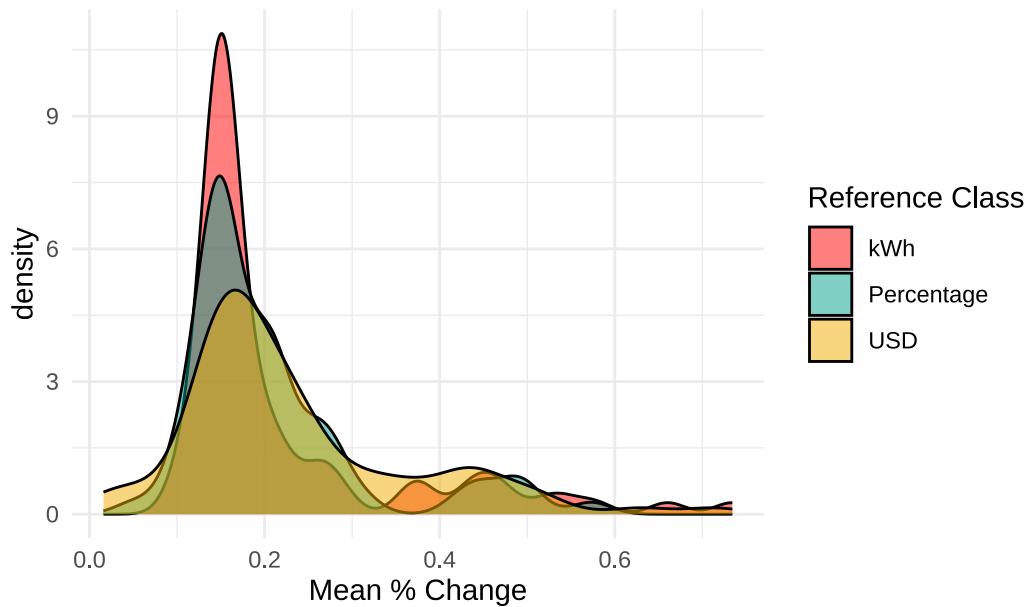
Source	State average	Exact	Rounded
Cooling	322	419	0
Heating	19,108	26,751	27,000

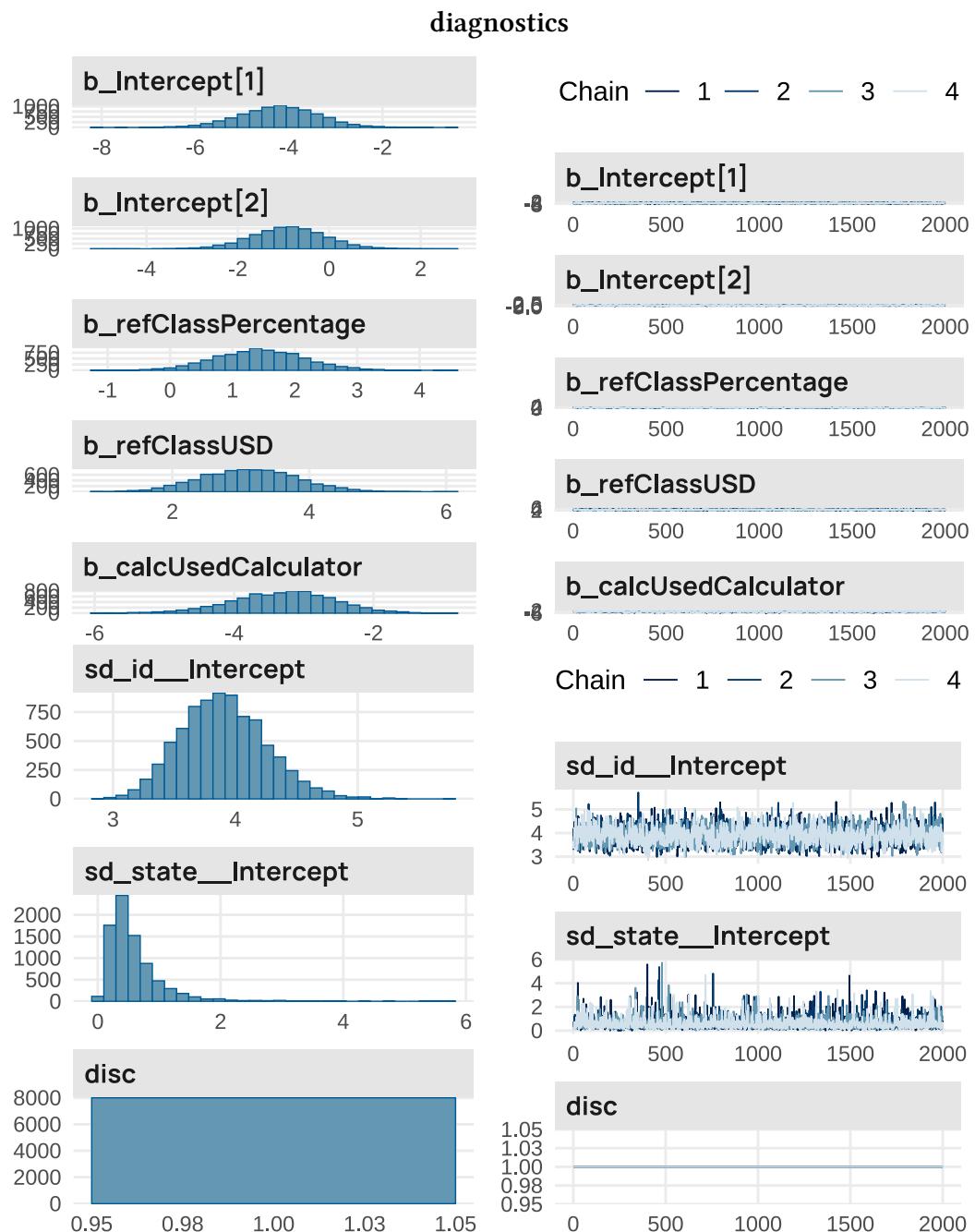
Source	State average	Exact	Rounded
Water heating	5,070	10,543	11,000
Refrigerator	1,025	1,230	1,000
Other	6,682	7,350	7,000
Total	32,207	46,293	46,000

Subject Counts

```
# A tibble: 3 x 3
total_subjects refClass    subjects_per_refClass
<int> <fct>          <int>
1      229 kWh            76
2      229 Percentage     67
3      229 USD             86

# A tibble: 3 x 3
total_subjects refClass    subjects_per_refClass
<int> <fct>          <int>
1      190 kWh            68
2      190 Percentage     67
3      190 USD             55
```

Demographics S1**Demographics S2****Study 1*****Amount of change*****S1. Mean % Change by Reference Class****S1. Mean % Change Density by Reference Class**



Study2

*Tables*

Table 13: Study 2: The table shows the percentage of participants who fell into each accuracy level for each reference class condition (percentages of kWh, \$, and USD columns reflect within condition percentages). The combined group column reflects the percentage of participants in each accuracy level when aggregating across all reference class conditions.

Accuracy Level	kWh	Percentage	USD	Combined Groups %
Exact match	44.1%	27.6%	19.5%	23.4%
0.01-5% error	14.7%	25.4%	15.9%	14.1%
Over 5% error	41.2%	47%	64.5%	37.5%

Table 14: Study 2: The table shows the percentage of participants who fell into each accuracy level for each reference class condition (percentages of kWh, \$, and USD columns reflect within condition percentages). The combined group column reflects the percentage of participants in each accuracy level when aggregating across all reference class conditions.

Accuracy Level	kWh	Percentage	USD	Combined Groups %
Exact match	44.1%	27.6%	19.5%	23.4%
0.01-5% error	14.7%	25.4%	15.9%	14.1%
Over 5% error	41.2%	47%	64.5%	37.5%

?@tbl-s2-prop shows that, once again, participants in the kWh condition achieved closer alignment with the target goals (44% exact matches), followed by Percentage (27%) and USD (18%). These percentages are consistent with the patterns observed in Study 1, reinforcing the conclusion that providing goals in kWh supports better accuracy.

Model Tables

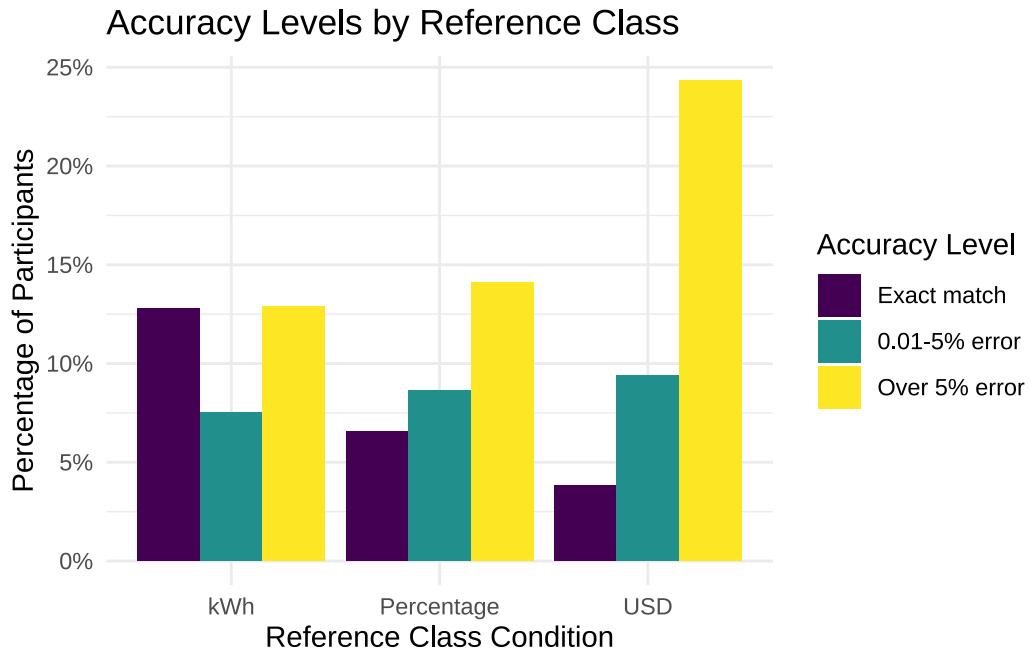


Figure 1: Study 1: Proportion of participants in each accuracy level, colored by reference class. A larger % of participants in the Exact Match bin indicates better performance.

term	group	contrast	pct_goal	estimate	conf.low	conf.high
refClass	Exact match	Percentage - kWh	10%	-0.07	-0.19	0.04
refClass	Exact match	USD - kWh	10%	-0.15	-0.26	-0.03
refClass	0.01-5% error	Percentage - kWh	10%	0.00	-0.02	0.02
refClass	0.01-5% error	USD - kWh	10%	-0.02	-0.06	0.01
refClass	Over 5% error	Percentage - kWh	10%	0.07	-0.05	0.19
refClass	Over 5% error	USD - kWh	10%	0.17	0.04	0.29
refClass	Exact match	Percentage - kWh	15%	-0.07	-0.19	0.04
refClass	Exact match	USD - kWh	15%	-0.15	-0.27	-0.03
refClass	0.01-5% error	Percentage - kWh	15%	0.00	-0.01	0.03
refClass	0.01-5% error	USD - kWh	15%	-0.01	-0.05	0.02

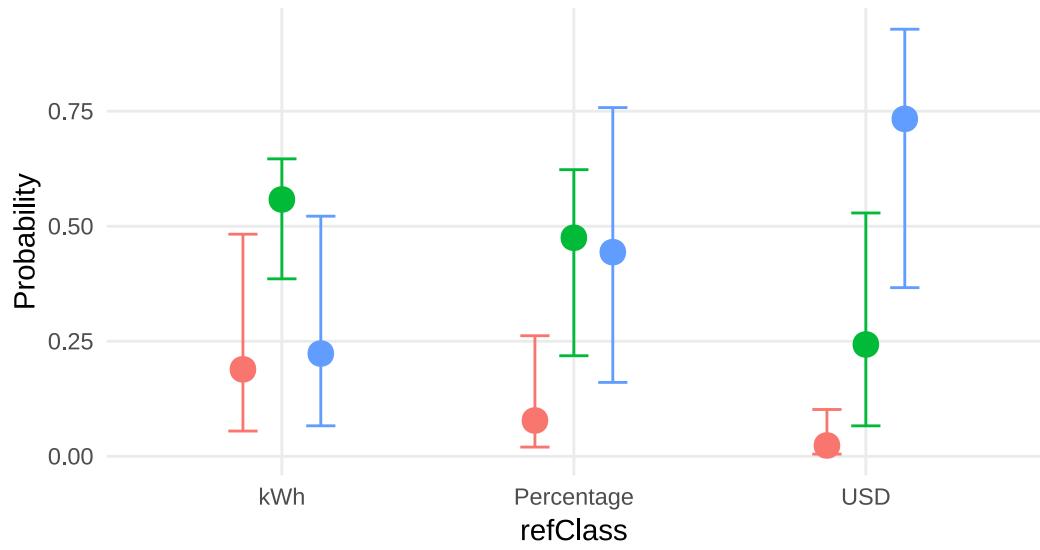
term	group	contrast	pct_goal	estimate	conf.low	conf.high
refClass	Over 5% error	Percentage - kWh	15%	0.07	-0.04	0.18
refClass	Over 5% error	USD - kWh	15%	0.17	0.04	0.29

group	refClass	estimate	conf.low	conf.high
Exact match	kWh	0.42	0.34	0.51
Exact match	Percentage	0.34	0.27	0.43
Exact match	USD	0.25	0.18	0.35
0.01-5% error	kWh	0.21	0.17	0.24
0.01-5% error	Percentage	0.21	0.18	0.25
0.01-5% error	USD	0.20	0.16	0.23
Over 5% error	kWh	0.37	0.29	0.46
Over 5% error	Percentage	0.44	0.36	0.53
Over 5% error	USD	0.54	0.45	0.65

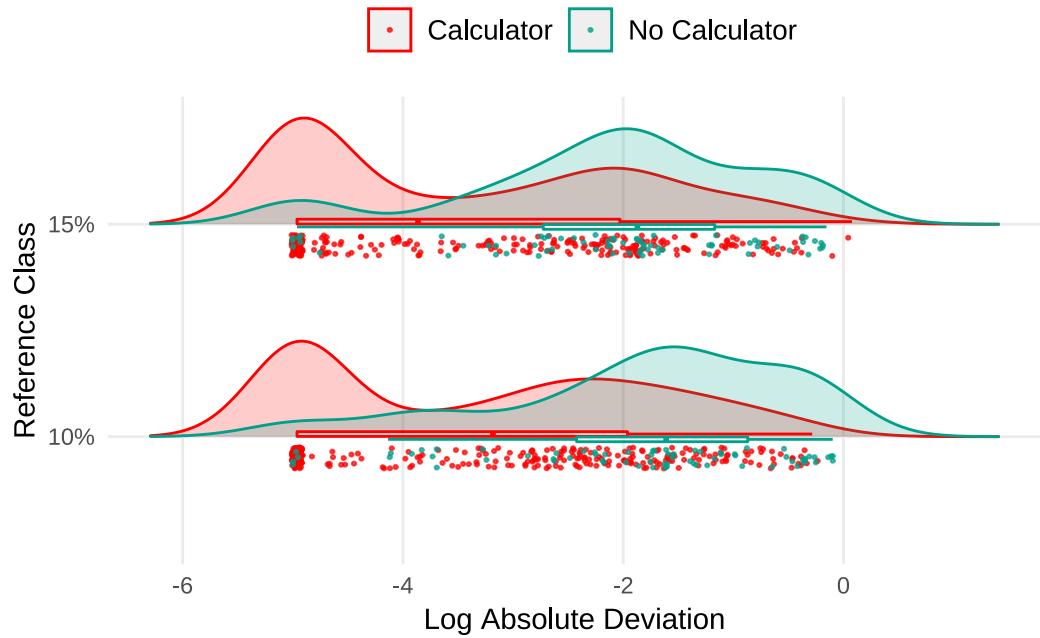
term	group	contrast	estimate	conf.low	conf.high
refClass	Exact match	Percentage - kWh	-0.07	-0.19	0.04
refClass	Exact match	USD - kWh	-0.15	-0.27	-0.03
refClass	0.01-5% error	Percentage - kWh	0.00	-0.01	0.02
refClass	0.01-5% error	USD - kWh	-0.02	-0.05	0.01
refClass	Over 5% error	Percentage - kWh	0.07	-0.05	0.19

term	group	contrast	estimate	conf.low	conf.high
refClass	Over 5% error	USD - kWh	0.17	0.04	0.29

accuracy_level • Exact match • 0.01-5% error • Over 5% error



Goal Manipulation



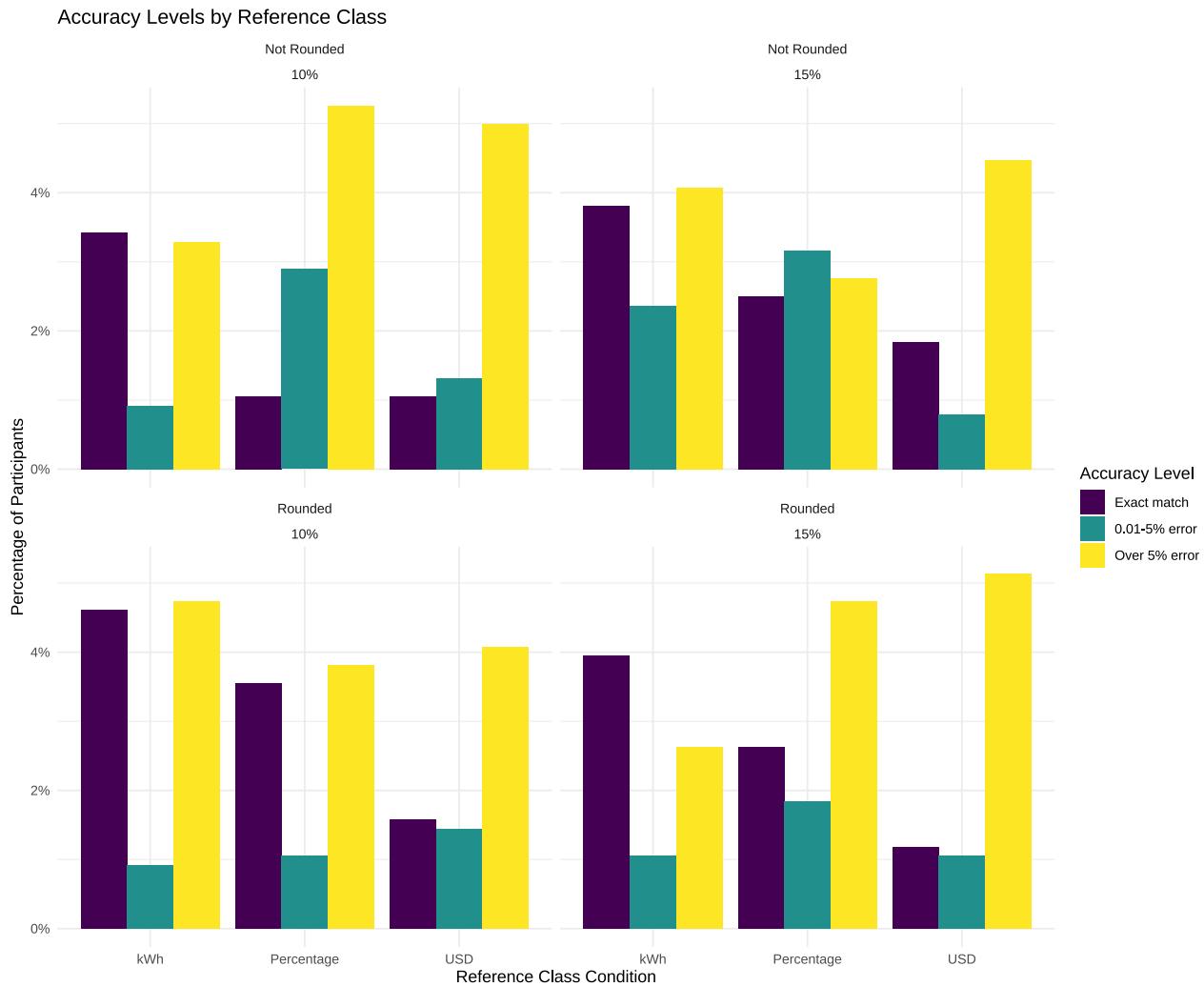


Figure 2: Experiment 2. Proportion of participants in each accuracy level, colored by reference class, and separated in facets based on the levels of reduction goal, and rounding. A larger % of participants in the Exact Match, or 0.01-2% error bins indicates better performance.

S1. % of Participants within each Accuracy Bin

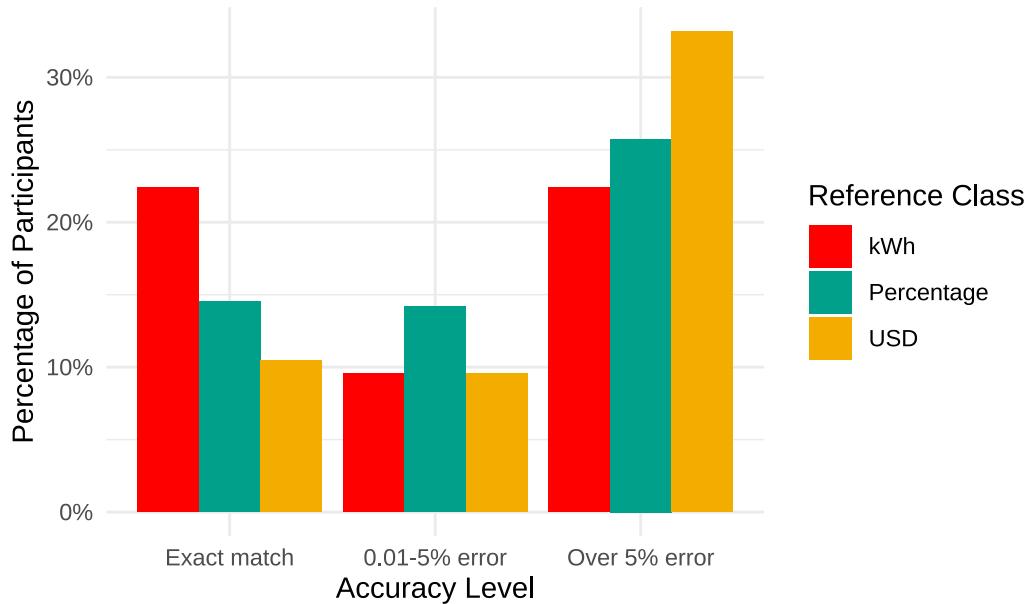
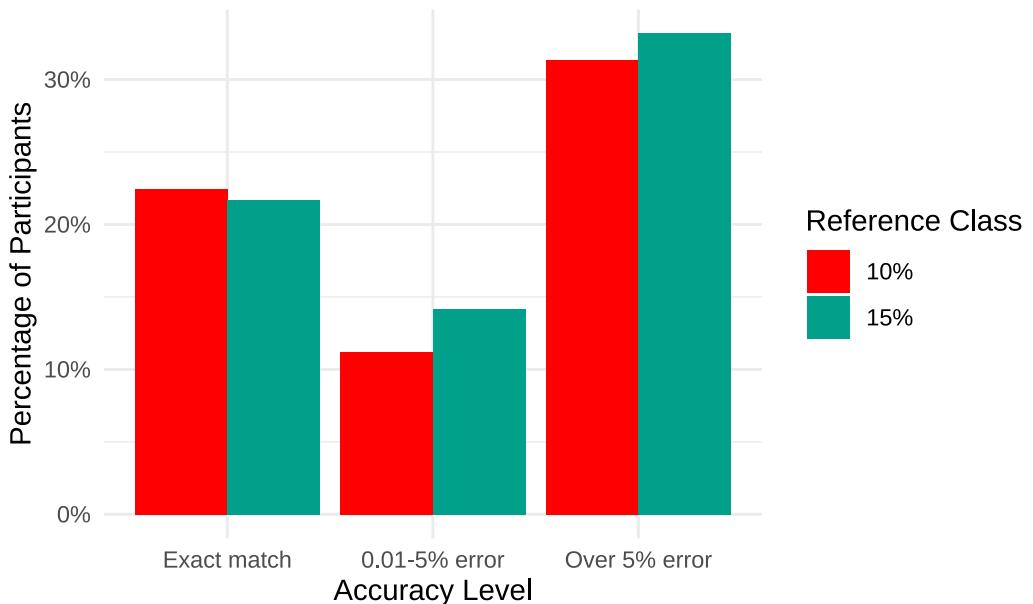


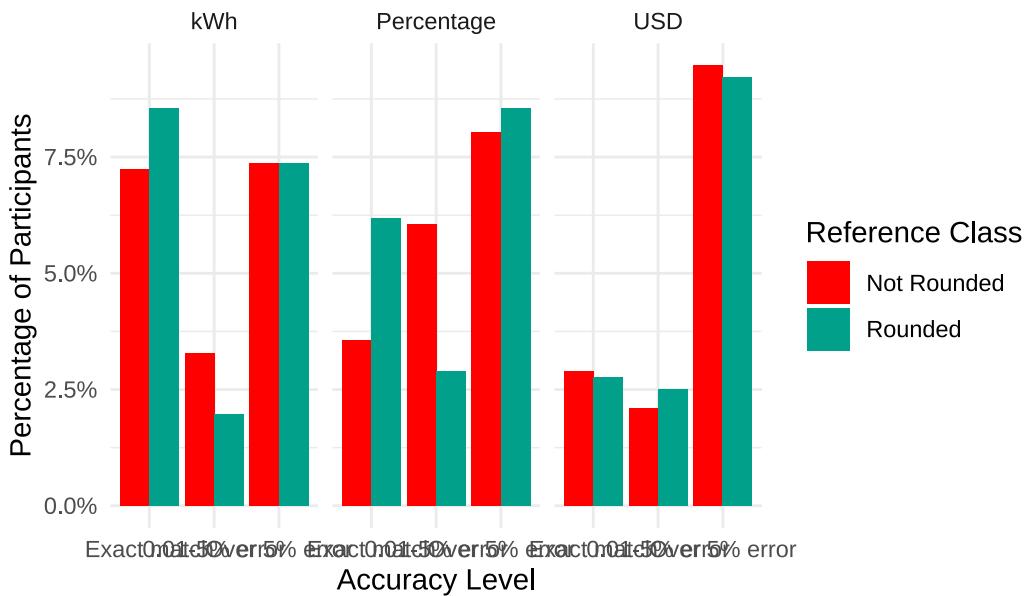
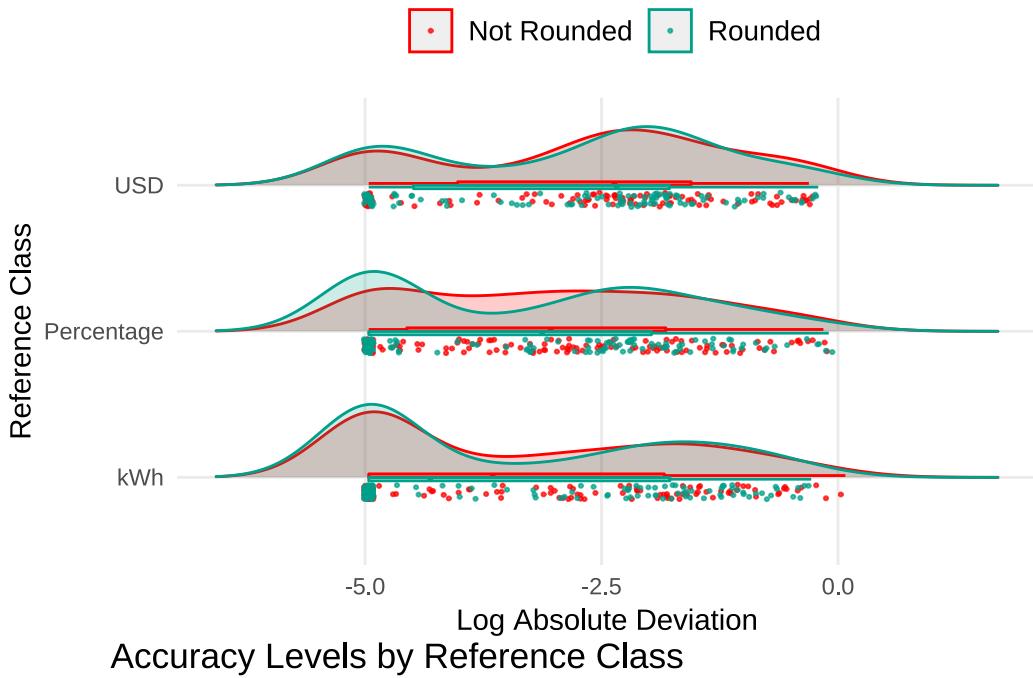
Figure 3

S1. % of Participants within each Accuracy Bin





Rounding



Individual Differences

As in Experiment 1, we further investigated the role of individual differences in energy literacy in predicting planning accuracy. A Bayesian linear regression model, analogous to the one used in Experiment 1 ($\log_abs_error \sim \text{els} + (1|\text{id}) + (1|\text{state})$), revealed a significant negative

relationship between energy literacy scores and log-transformed absolute error (Estimate = -3.21, 95% CI: -3.89 to -2.52). This finding indicates that participants with higher energy literacy scores tended to produce more accurate plans, exhibiting smaller deviations from the target reduction goals. The conditional effect plot (?@fig-s2-els) visually confirms this relationship, showing a clear decreasing trend in log absolute error as energy literacy increases.

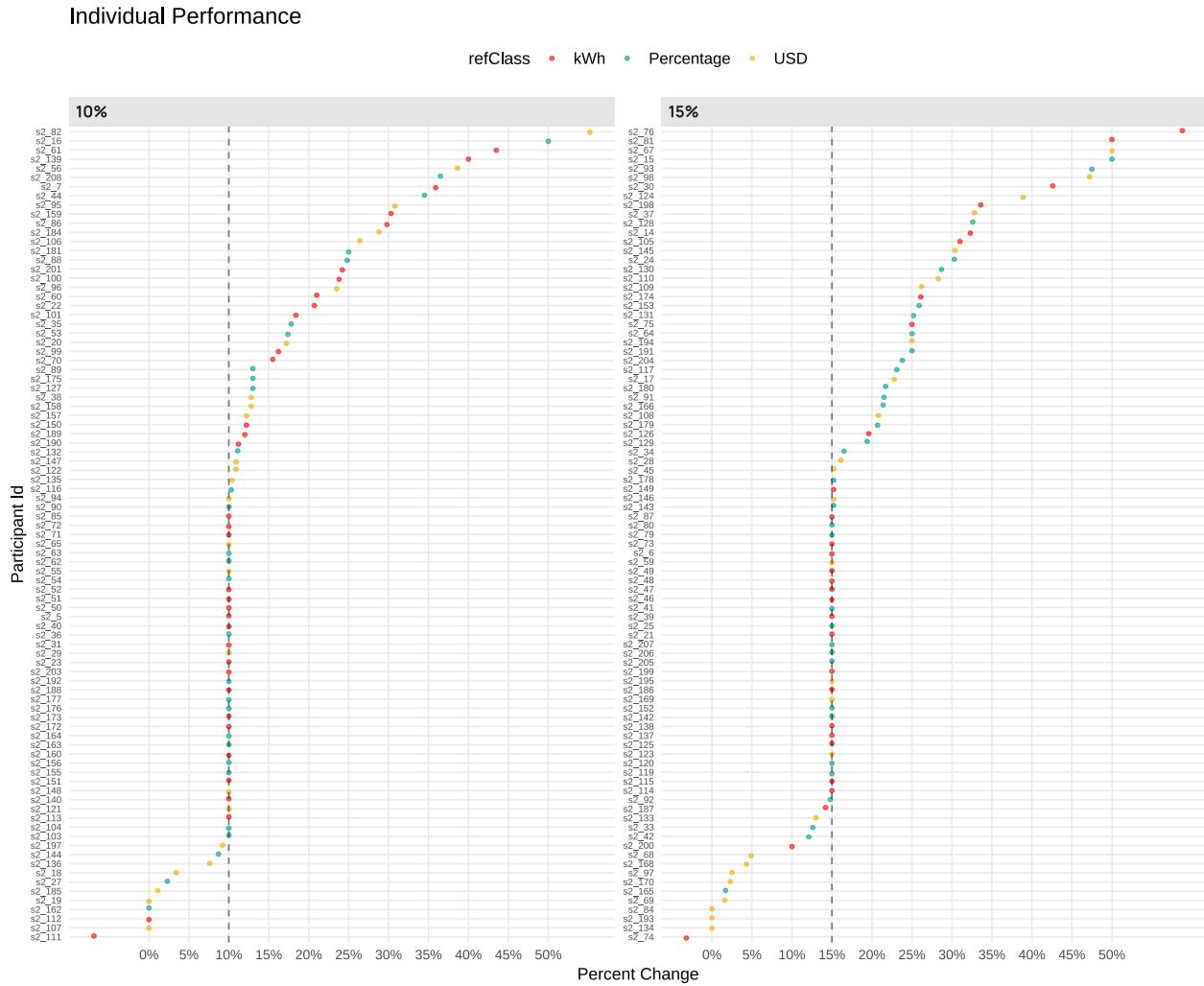


Figure 4: Study 2: Individual performance in the energy planning task, colored by reference class. The dashed line represents the target reduction goal. Participants are shown along the y axis, those who fall above or below the dashed line have not met the target goal. The x-axis represents the percent change in energy usage from the prior year.

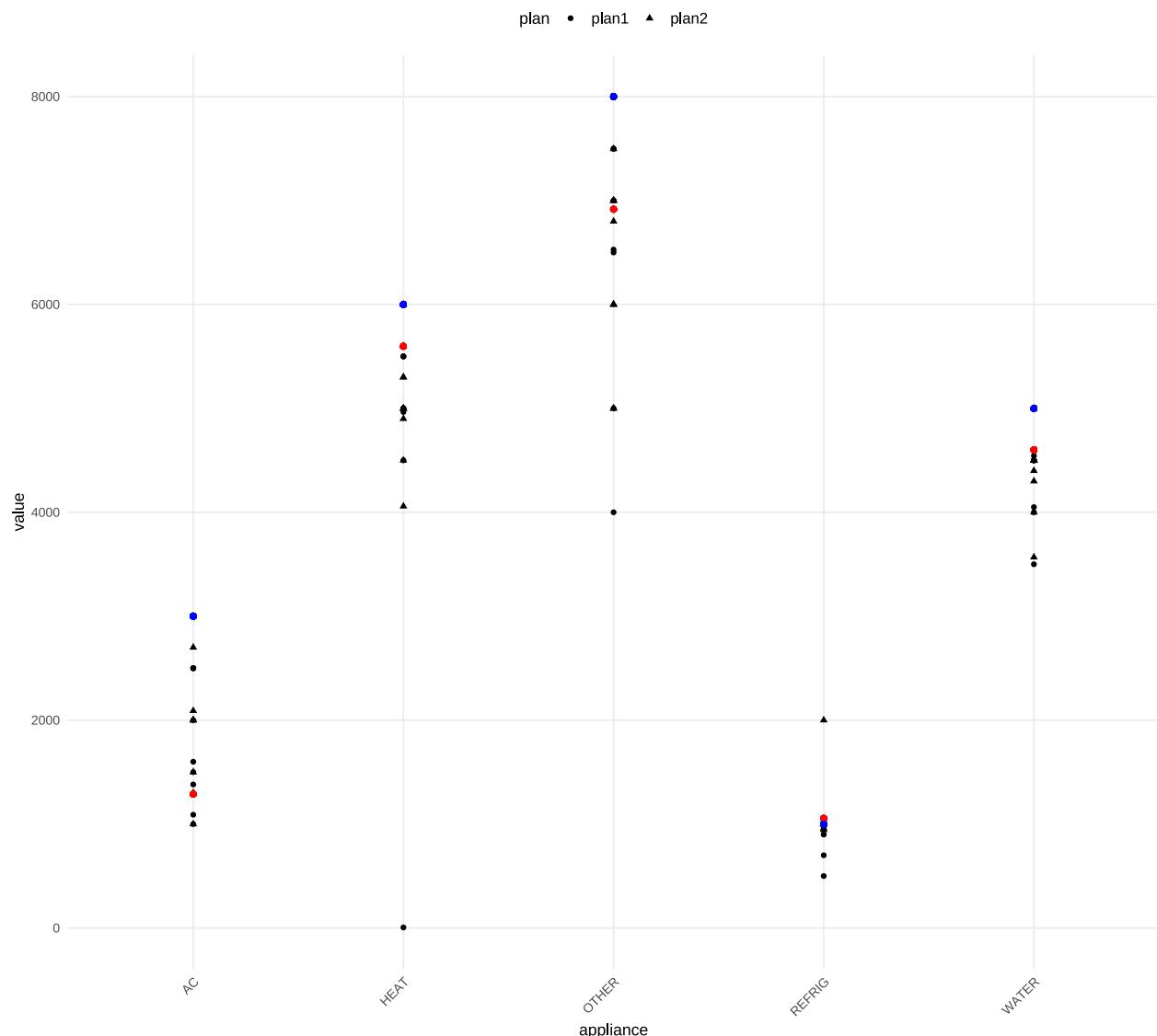


Figure 5: Study 2: Responses patterns for a subset of individual participants. Black points are participant responses, red points are the state average, and blue points are the family average. The x-axis represents the appliance category, and the y-axis represents the energy usage in kWh.

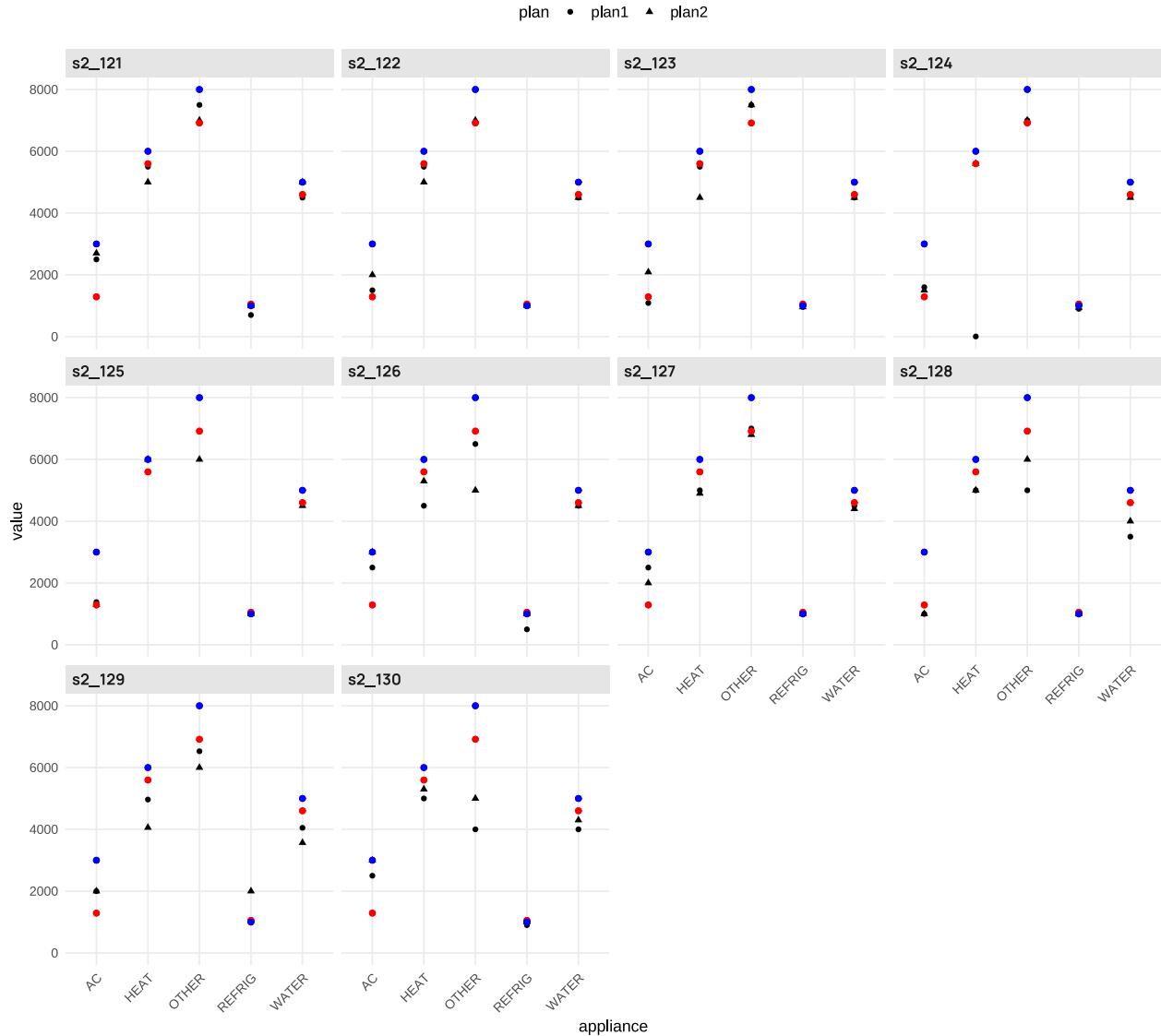


Figure 6: Study 2: Responses patterns for a subset of individual participants. Black points are participant responses, red points are the state average, and blue points are the family average. The x-axis represents the appliance category, and the y-axis represents the energy usage in kWh.

Tables**Distance plots**

Additional data collected included:

- **Energy Literacy Quiz:** An 8-item questionnaire assessing participants' knowledge of energy consumption and conversion (DeWaters & Powers, 2011).
- **Calculator Usage Tracking:** Questions determined whether participants used a calculator, paper/pen, or other methods to complete the tasks.
- **Demographic Survey:** Collected information on gender, age, income, education, employment status, and state of residence.
- **Environmental Attitudes Survey:** Assessed participants' pro-environmental attitudes and perceived importance of energy conservation.

DeWaters, J. E., & Powers, S. E. (2011). Energy literacy of secondary students in New York State (USA): A measure of knowledge, affect, and behavior. *Energy Policy*, 39(3), 1699–1710. <https://doi.org/10.1016/j.enpol.2010.12.049>

Table 18: Study 2: Summary of planning accuracy by reference class. The table shows performance as both the % of trials where participants matched the goal, and the mean absolute error from the target reduction goal.

