Global scenarios and assessing company (or sector) climate transition risk – issues and opportunities

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Rapid System Transitions Towards Low GHG Futures
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Context

- Increasing interest in analyzing company climate-related risks (policy/transition and physical) and/or setting GHG goals

- Methodologies being offered using global emissions scenarios, e.g.,
  - SBTi – IEA 2DS scenario
  - UNEP FI pilot – REMIND CD-LINKS scenario

- Analyses technically challenging and general unfamiliarity with the science
  - Scientific knowledge vast and well beyond what's being considered

- Need to slow down and develop a proper scientific basis for these applications
  - Sound scientific understanding is a requisite first step for grounded dialogue & decisions

- EPRI project helping to advance technical understanding, discussion, and decisions

…and more

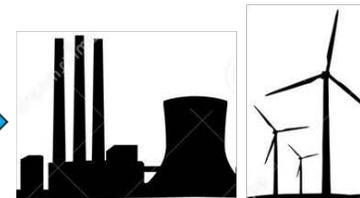EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Global climate goals and the relationship to companies?

EPRI research evaluating the relationship between a company and a global average temperature goal

Climate goals
(e.g., limit < 2°C)
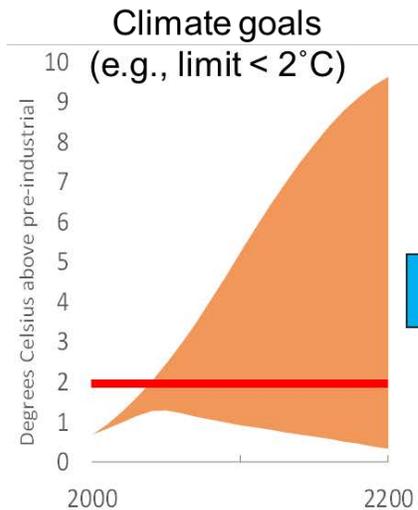
Company

?

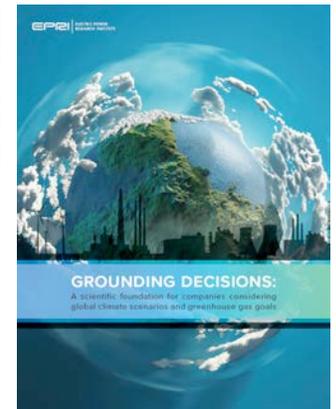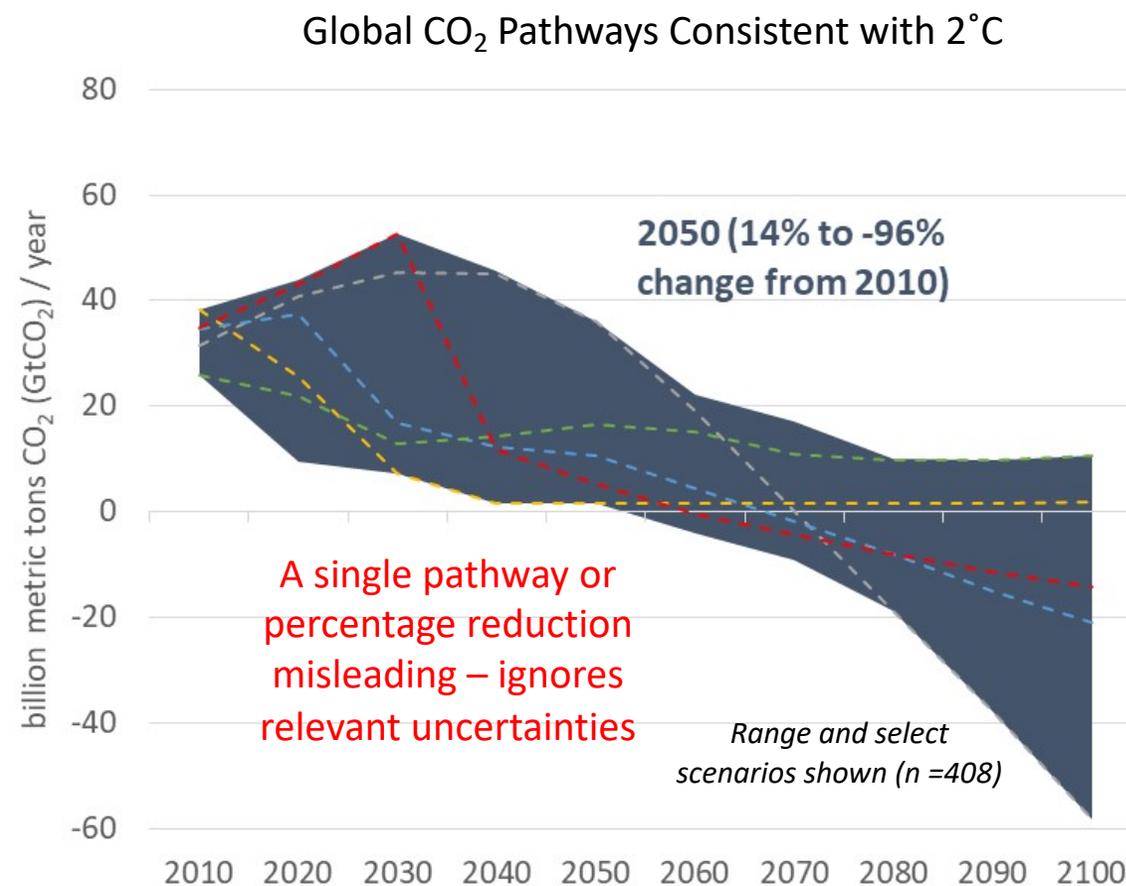- Initial EPRI study (below) analyzes and characterizes current scientific understanding and identifies technical issues and insights for companies and stakeholders

- Ongoing analyses exploring knowledge gaps and new information

Grounding Decisions: A Scientific Foundation for Companies Considering Global Climate Scenarios and Greenhouse Gas Goals (#3002014510, www.epri.com)

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Summary of key observations (paraphrased)

1. Significant global emissions scenario resources are available, but appropriate interpretation critical

2. Broad ranges of CO_2 pathways and budgets are consistent with a temperature outcome

3. Assumptions matter for properly using results – policy design & technology in particular important for companies (sectors and countries)

4. Policy design a key additional uncertainty for companies

5. Applying uniform GHG targets (e.g., 80% in 2050) across companies is unlikely to be cost-effective for society

6. 2˚C and below pathways extremely challenging – global emissions pathway attainability another uncertainty for companies that implies even larger range of global emissions pathways is relevant for companies

7. Other risks (non-climate-policy) & current company strategy matter

8. GHG emissions only one part of an asset's or portfolio's value

9. Despite broad ranges, there are robust insights

Global CO_2 Pathways Consistent with 2˚C

2050 (14% to -96% change from 2010)

A single pathway or percentage reduction misleading – ignores relevant uncertainties

Range and select scenarios shown (n =408)

From this we derived key insights for companies and stakeholders

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On-going EPRI research

- Further expanding the scientific foundation

- E.g.,
    - Evaluating policy design uncertainty implications and importance
    - Developing guidance for operationalizing scientific insights
    - Assessing new global emissions scenarios data (e.g., IPCC 1.5°C Report)

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Scientific issues and opportunities

Global emissions scenario data limitations & opportunities
(preliminary)

Limitations

1. A single scenario misleading

2. Statistics & representative scenarios misleading

3. Subglobal results problematic

4. All scenarios not equally likely

5. Uncertainties missing

6. Overall, global scenarios not designed to inform company level thinking

Opportunities

1. Use ensembles

2. Use ranges and robust insights

3. Avoid, instead explicitly evaluate uncertainties

4. Consider plausible scenarios & likelihoods

5. Consider additional uncertainties (e.g., policy design, scenario likelihood, company specific)

6. Use key insights to guide analysis and assessment – principles and analytical guidance

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A single scenario misleading, ensembles appropriate

- **Single scenario doesn't represent uncertainty evident in the literature and relevant to decisions**
  - **Being in the range is not enough!**

- A scenario is not a forecast, prescription, or requirement
  - Extremely sensitive to alternative plausible assumptions

- Sets of scenarios—ensembles—from different models and assumptions can help us characterize uncertainty, and identify key sources of uncertainty

Global Energy CO$_2$

Not representing uncertainty evident in the literature for pathways consistent with 2°C

Legend:
- Consistent with < 2 degrees C
- Other pathways peaking before mid-century
- SBTi / IEA
- UNEP FI

Rose and Scott (2018)

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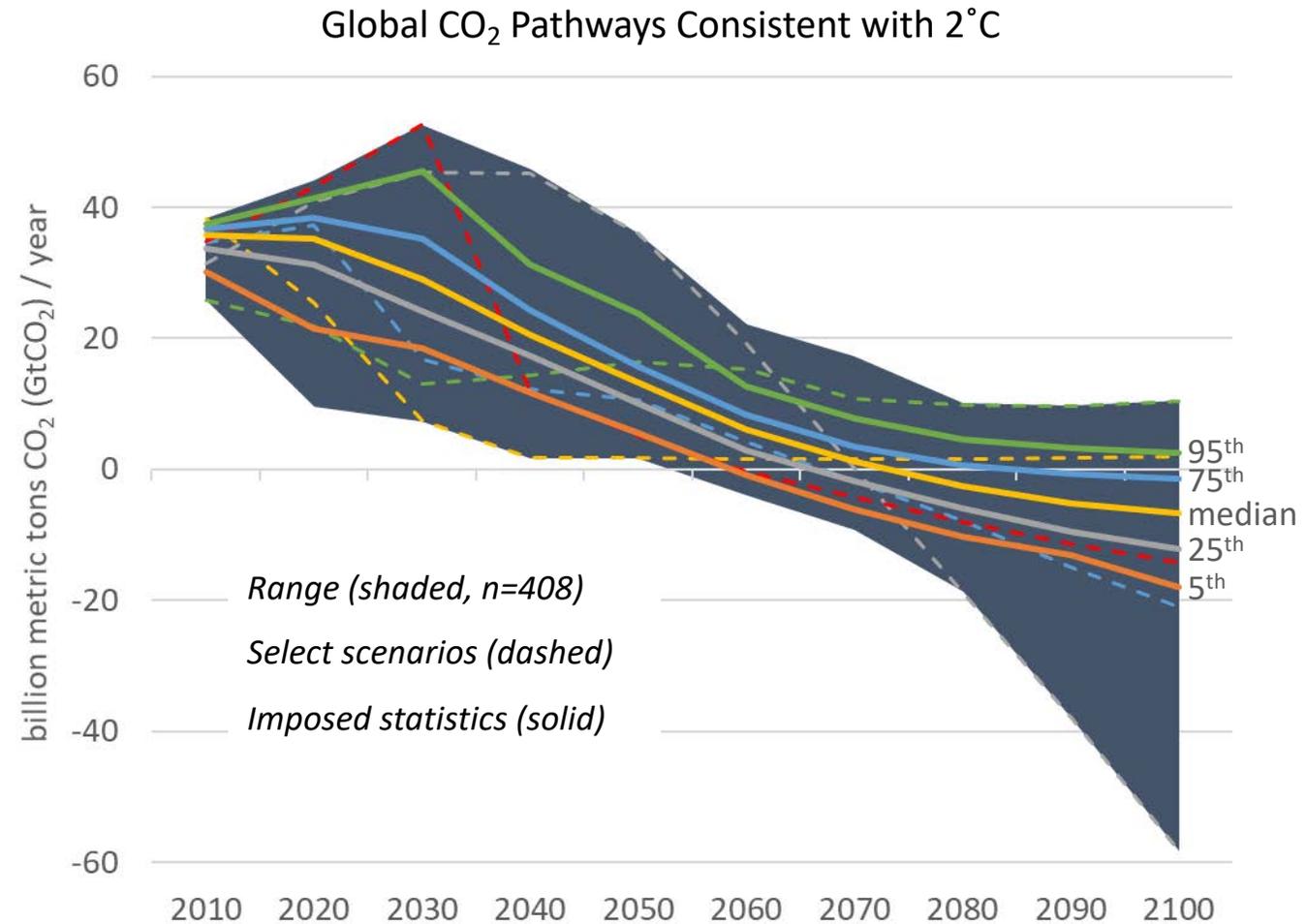# Characterizing ensembles, ranges most appropriate

- **Scenarios literature provides ad hoc results with no probabilistic interpretation**
  - Results not random samples, variation arbitrary
  - Over- and under-sampling biases in datasets
  - Only partial uncertainty represented – not sampling over uncertain inputs and parameters

- **Thus, ensembles are not distributions and not amenable to summary statistics** (e.g., means, medians, standard deviations, percentiles)
  - No basis for weighting results to identify more likely or "better" estimates (or less likely or "worse")
  - Statistics misleading – truncating data and suggesting confidence without basis

- **Ranges the most appropriate characterization of ensemble uncertainty**

Model Name	Number of Scenarios
AIM-Enduse	41
BET	23
DNE21	43
EC-IAM	21
Ecofys	1
ENV-Linkages	17
FARM	12
GCAM*	139
GEM-E3	11
GRAPE	14
GTEM	4
IEEJ	2
IGSM	5
IMACLIM	53
IMAGE	79
iPETS	4
KEI-Linkages	4
MARIA	5
MERGE	44
MERGE-ETL	48
MESSAGE	140
Phoenix	31
POLES	79
REMIND	158
SGM	7
TIAM-ECN	12
TIAM-WORLD	41
TIMES-VTT	6
WITCH	132
WorldScan	8
TOTAL	**1184**

Rose and Scott (2018)

Characterizing ensembles, statistics misleading

- Imply a distribution without any basis
- More importantly, suggest better & worse information (e.g., implying confidence and outliers)
  - Need criteria for exclusion
- Statistics are not coherent pathways
  - Not internally consistent
  - e.g., median "pathway" vs actual pathways in figure

Global CO_2 Pathways Consistent with 2˚C

Range (shaded, n=408)

Select scenarios (dashed)

Imposed statistics (solid)

95th
75th
median
25th
5th

Developed from Rose and Scott (2018)

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Scenario ranges are valuable information: lessons from Florence

- **The set of results informs planning by identifying possibilities**

- All decision-relevant information. Anything less can mislead.

- Note: key difference from global emissions projections – hurricane paths are forecasts (vs. projections)

AL06 Florence Guidance: 12z 11 Sep 2018

Model guidance only. Expert interpretation required. Check NHC official forecasts.

Refresh every 30 minutes for the most recent data.

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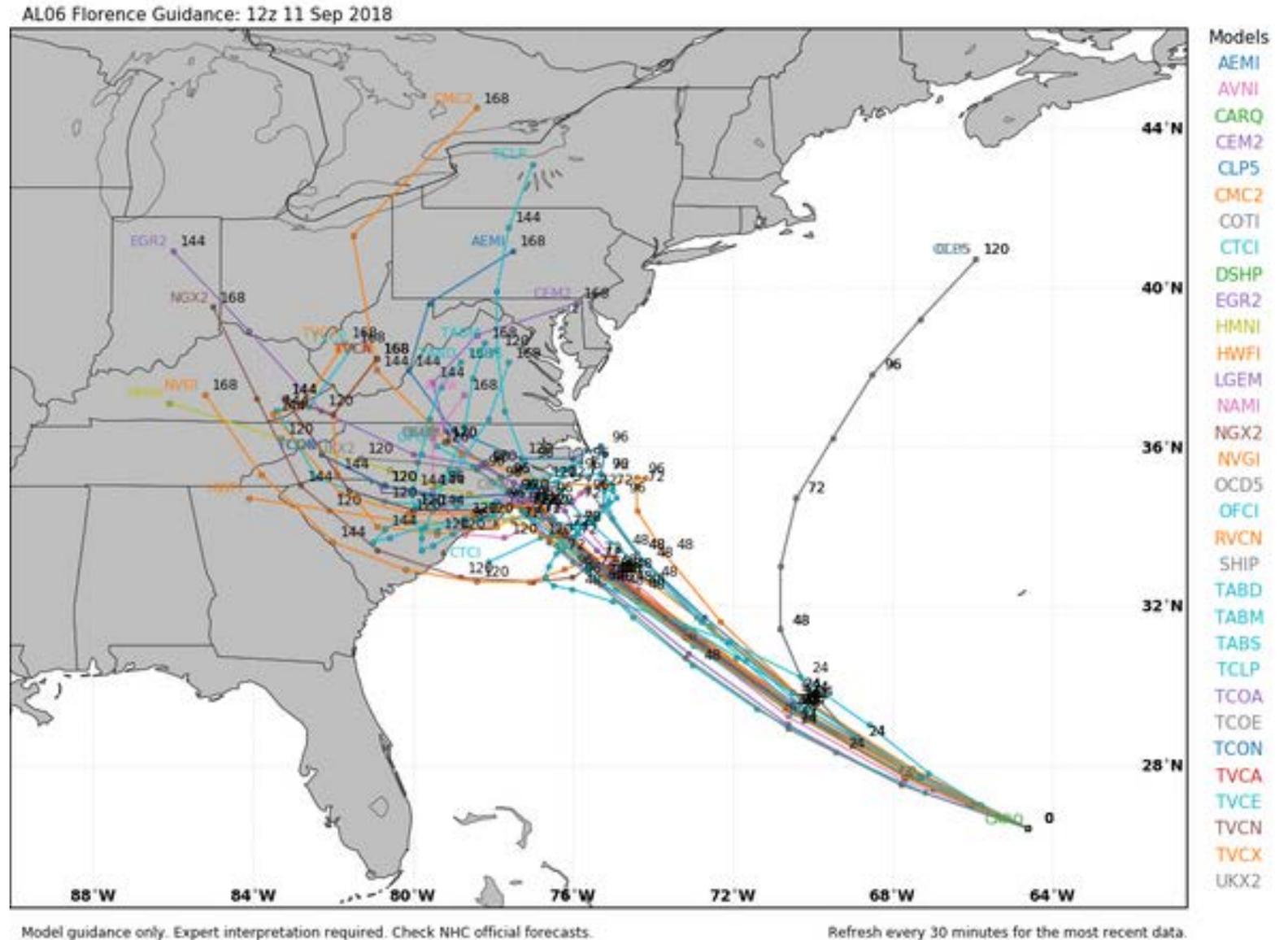
Subglobal results problematic

- Subglobal results from global scenarios (e.g., region, sector, region-sector) being applied to companies
  - And, some wanting even more disaggregation

- **However subglobal results...**
  1. **Contingent on assumptions that are uncertainties needing evaluation (e.g., policy design, technology)**
  2. **Represent aggregate markets, not companies**
  3. **Results suggest economically inefficient action (suggest uniform targets)**
  4. **Missing key uncertainties (e.g., policy design, company specific)**
  5. **Have even greater uncertainty – increases with resolution (problem for downscaling)**

Global 2050 electrification from current 2˚C scenarios
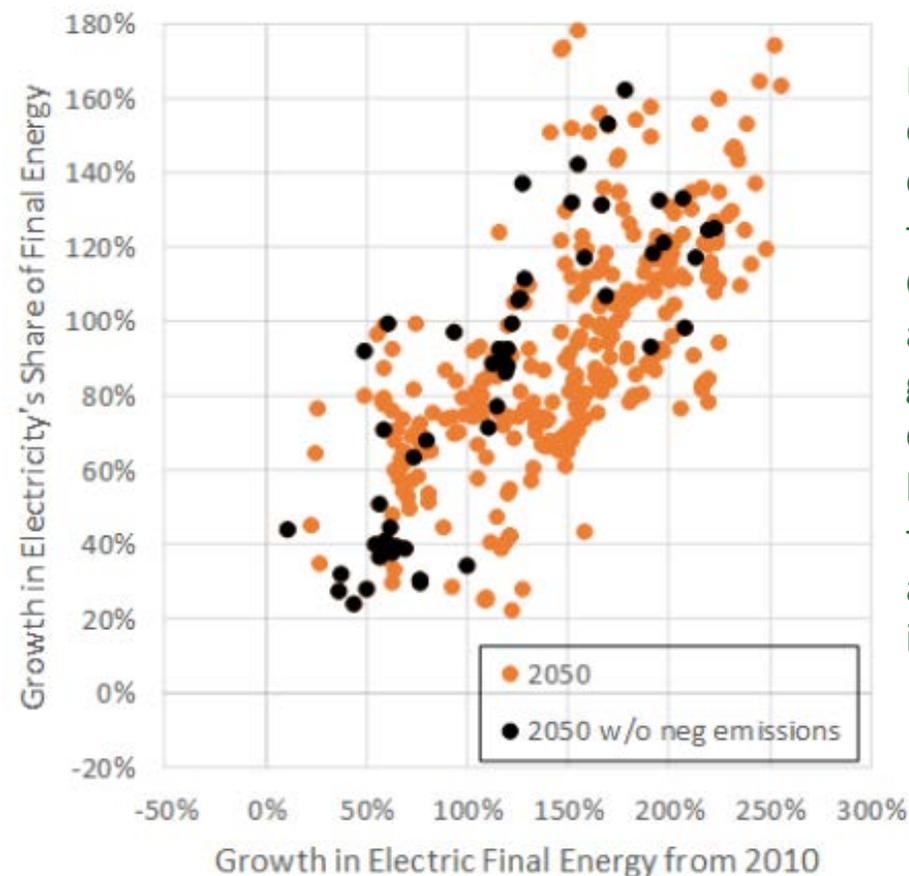
Is increasing electrification consistent with the 2˚C goal? Global scenarios assume idealized global policy and cost-effective low carbon technologies available. What if not?

Rose and Scott (2018)

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Likelihood of global pathways relevant

- 2˚C and 1.5˚C pathways extremely challenging – geophysically, technologically, economically, politically
- As a result, low likelihood they will occur
- How do we communicate and use this information?
  - Other global pathways relevant (e.g., pathways that peak later) as are assigning probabilities

Global total net CO_2 emissions

Billion tonnes of CO_2/yr

1.5˚C pathways – Global CO_2 peaking by 2020 and declining rapidly with global economy-wide policy and significant negative emissions deployment. Notable infeasible results as well.

SR1.5
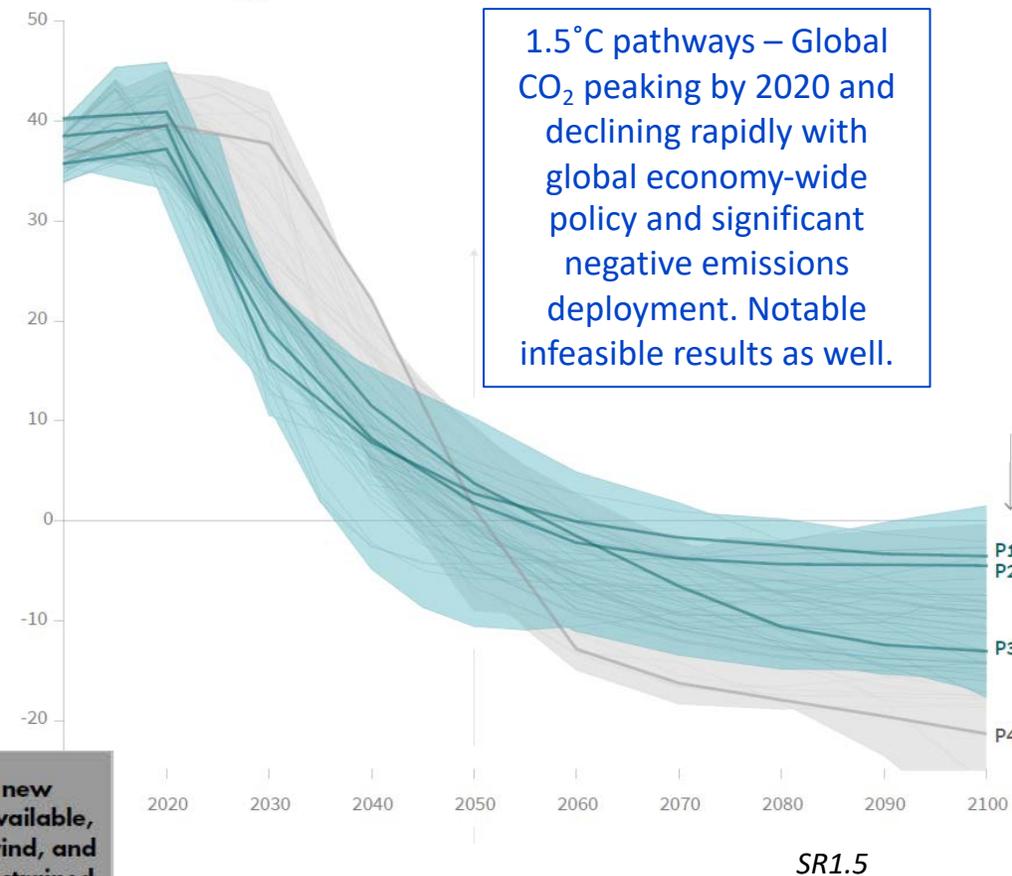
models producing scenario / # models that tried

	Full default technology	CCS unavailable (fossil and bioenergy)	New nuclear unavailable and phase out of existing	Solar and wind electricity share constrained	Biomass supply constrained	CCS and new nuclear unavailable*	CCS and new nuclear unavailable, and solar, wind, and biomass constrained
Higher atmospheric concentration target (550 ppm CO_2eq)	13/13	12/12	11/11	11/11	13/13	12/12	6/9
Lower atmospheric concentration target (450 ppm CO_2eq)	10/11	4/11	9/10	9/10	9/11	6/11	0/10

Krey et al. (2014)

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Missing uncertainties – what's "right" for a company depends on the policy design

(e.g., electric company 2050 CO_2 reductions with 80% goals and different policy designs)

preliminary

Different societal cost implications
➔ Need to balance priorities.

Three different policy contexts, three different economical responses (e.g., Company 6)
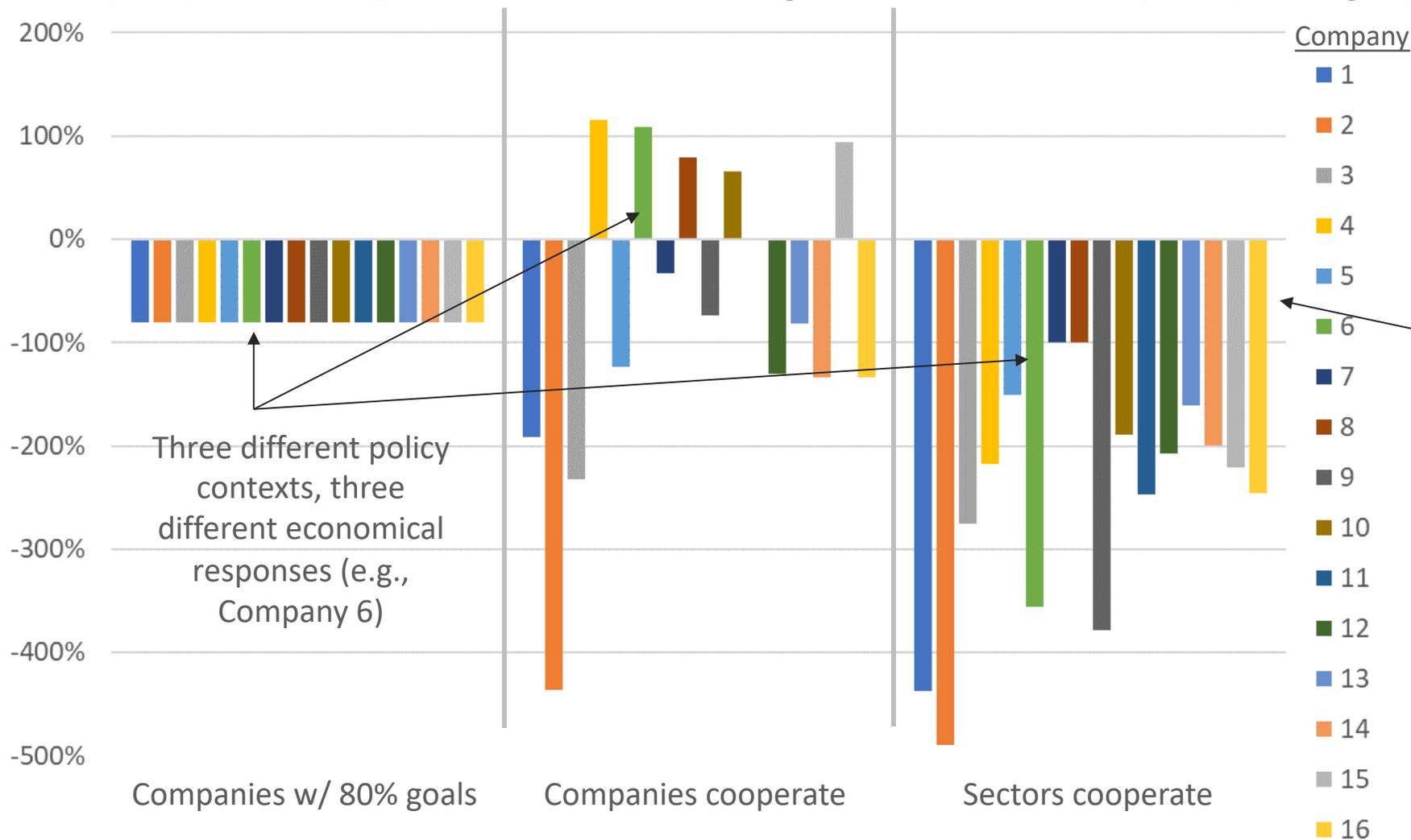
Only with economy-wide cooperation do we find all electric companies reducing CO_2, and potentially by more than 80%

Companies w/ 80% goals   Companies cooperate   Sectors cooperate

Company
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

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Opportunity to identify robust insights from ranges

Despite broad ranges, insights found consistently across models and assumptions that provide a solid decision-making foundation for companies and others

For instance

- Global emissions must peak and decline for goals equal to or more ambitious than a 50% chance of limiting global warming to 3˚C

- An emissions pathway cost-effective for a given set of assumptions will not be cost-effective for every plausible future

- The cost-effective emissions reduction role of an economic sector is highly uncertain

- The emissions relationship with global temperature becomes increasingly uncertain the finer the resolution of the emissions source

- And more…

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Current global scenarios poor benchmarks for company and sector assessments

preliminary

Problems for companies trying to be "consistent" with a climate goal, and for using global scenario results as a benchmark to evaluate companies

- Many consistent pathways

- Some pathways may not be likely

- Results do not represent companies, and some companies operate in more than one sector

- Pathways contingent on assumptions and missing uncertainties that affect companies

- Companies pursuing the same emissions effort costly for society

- Subglobal results problematic

Opportunity: use insights, instead of scenario quantifications, to guide company analysis and assessment

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Key insights represent principles for evaluating & developing methodologies

A technical checklist for methodologies

Company analysis issues for methodologies

- Uncertainties considered and how?
  - Temperature-emissions
  - Global pathway attainability
  - Policy design
  - Non-climate-related
- Consideration of company-specific context?
- Uniform vs. varied GHG targets across companies?
- Consideration of flexibility options?
- Quantitative comparison of alternatives?
- Evaluation of strategy robustness?

EPRI *Grounding Decisions* Study (2018)

Table ES-3
How different approaches address company analysis issues identified by this study
Sources: Developed from this study, SBTi (2015, 2017), IEA (2016), Ceres (2018), and UNEP FI (2018)

Issue to consider		This study	SBTi	Ceres	UNEP FI pilot
Scenarios used		1000+ (a)	1 (b)	See note (c)	See note (d)
Uncertainties					
Global temperature-CO₂ relationship for 2°C (cumulative 2011-2050 GtCO₂)	Global net	465 to 1692	--	--	1139
	Global energy	324 to 1636	1085	--	1022
	Global electric	94 to 642	335	--	261
Global temperature-CO₂ relationship for 2°C (annual changes in 2050 relative to 2010)	Global net	14% to -96%	--	--	-72%
	Global energy	9% to -99%	-52%	--	
	Global electric	-2% to -163%	-89%		
	U.S. net CO₂eq	-58% to -110%			
	U.S. electric				

E.g.,
- Recent methodologies do not represent uncertainty evident in the literature related to 2°C.
- They also propose applying uniform targets across companies

			Not considered	Not considered	Not considered
	(...service demand, fuel markets, ...nology costs)		Not considered	Some discussion	Some discussion
Company-specific context	Important, varies from company-to-company (e.g., current assets, markets, systems, and policy & strategy)	Limited consideration (base year activity and emissions, target year activity)	Some discussion	Some discussion
Uniform vs. varied GHG targets across companies	Uniform targets found unlikely to be cost-effective	Proposes globally uniform sectoral targets	Proposes uniform target for all utilities	Implies uniform targets within sector segments
Company flexibility	Consider flexibility in GHG reduction levels and how achieved	Constrained to single GHG target without coordination	Constrained to single GHG target (coordination not considered)	Not considered
Quantitative comparison of company alternatives	Compare cost, environmental effectiveness, cost risk, and sensitivity of results	No method	Various potential comparisons noted (e.g., technology, cost)	Not discussed
Company strategy robustness	Evaluate by considering uncertainties and risk management	Not considered	Not considered	Not considered

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Operationalizing insights – transition risk assessment framework

- **<u>Company scenario analysis dimensions</u>**

  – Range of emissions reductions (e.g., 0%, 30%, 50%, 80%, 100%, >100% reductions in 2050)

  – Alternative policy designs (e.g., instrument, cooperation)

  – Alternative reference conditions (e.g., markets, technology)

- **<u>Valuable for evaluation and communication</u>**

  – Implications, uncertainty, risks for a reduction

  – Implications, uncertainty, risks across reductions

  – Cost-effective alternatives & required conditions

  – Relative importance of uncertainties

  – Risk of outcomes and being "wrong"

  – Risk management strategies

> **If picking an emissions reduction level…**this analysis facilitates communication of implications, uncertainties, risks in pursuing level, <u>required conditions for realizing level</u>, and strategy for managing risks (GHG & business)

> **Stress testing…**can use analysis to evaluate/communicate whether a strategy is practical for managing risks. For instance, is the strategy resilient for a possible future (i.e., can the company adjust and be viable)?

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Another issue: evaluating assets/companies in isolation

- We are seeing this in some methodologies
- To minimize societal costs, the full value of assets and investments should be considered, e.g., the value of electric power generation assets and portfolios are a function of a variety of factors:
  - Investment cost
  - Operating cost
  - Fuel cost
  - Regulatory cost – such as for air pollution, climate, and water management compliance
  - Power purchases
  - Power sales
  - System value – includes reliability value (operating capacity for reserve) and operability value (dispatchable capacity that can provide ancillary services and inertia)

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Concluding remarks

- **We need methodologies that do <u>ALL</u> of the following…**
  - Consider uncertainties evident in current science
  - Consider missing uncertainties
  - Recognize that companies are different from each other and aggregates
  - Consider system value

- **How to use global scenarios?**
  - Not currently meaningful quantitative benchmarks. Could they be turned into something meaningful for companies?
  - Provide useful qualitative insights that guide analysis. How might they provide additional insights in the future?

- **Maybe we need a different mindset? Evaluate company transition risk strategy, not on whether it aligns with a global scenario result, but on the process used to evaluate risks, e.g.,**
  - Has a company evaluated possible low carbon futures?
  - Have they evaluated the risks in those and other futures—GHG cost and to overall business?
  - Do they have a practical risk management strategy? For instance, is the strategy resilient (i.e., can they adjust and be viable)?

- **Companies need to manage risks by hedging. Picking a single future exposes a company to other risks. Note that, a risk management strategy can be multi-pronged.**

- **Insights here relevant to other contexts as well – decarbonization financing, IPCC uncertainty representations**

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Thank you!

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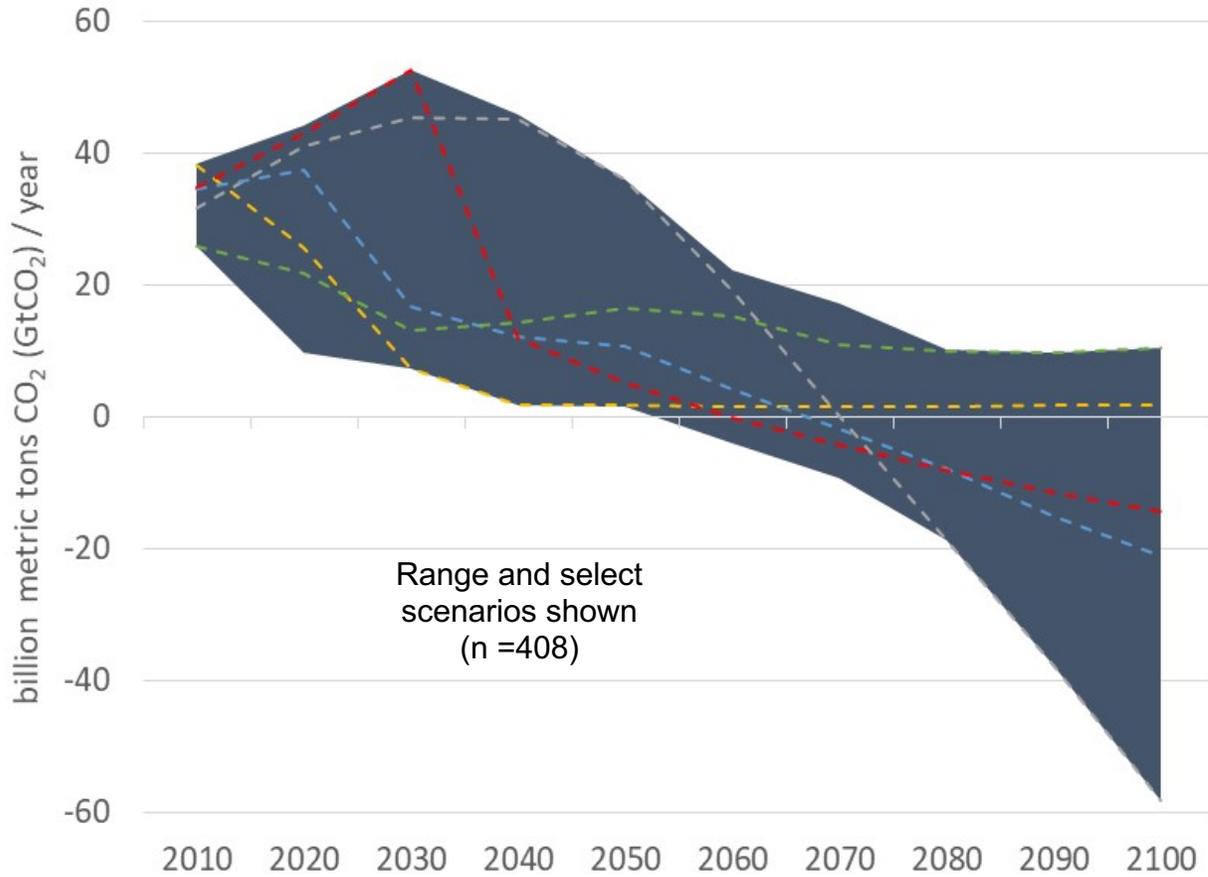EPRI | ELECTRIC POWER RESEARCH INSTITUTE

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- A non-advocacy, nonprofit, scientific research organization with a public benefit mandate

- EPRI strives to advance knowledge and facilitate informed discussion and decision-making

- Recognized expertise in, among other things, climate scenarios, energy transformation, policy evaluation, and sustainability, as well as research community leadership in, among other things, the Intergovernmental Panel on Climate Change (IPCC) and research community studies
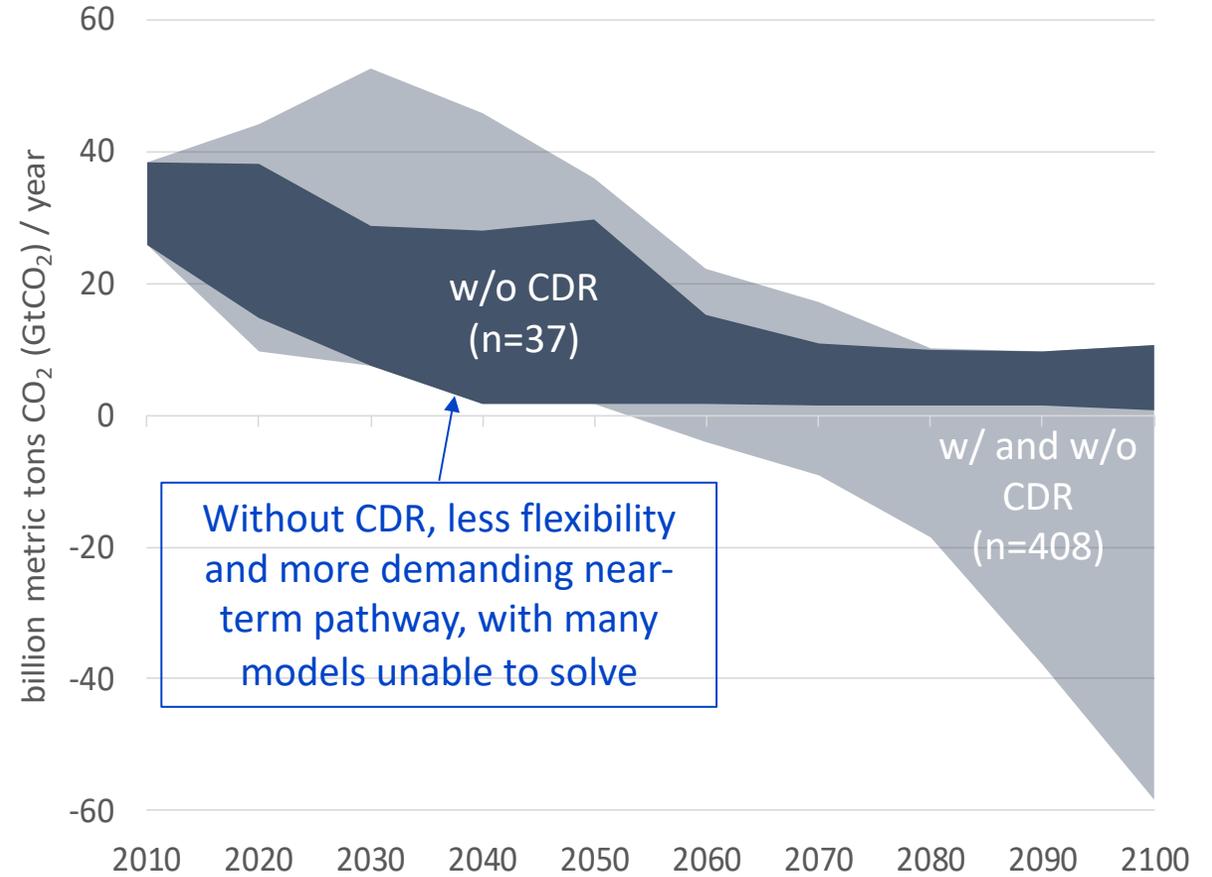
Without CDR…CO_2 Pathways

Global net CO_2 pathways consistent with limiting warming to 2°C

Range and select scenarios shown (n =408)

Ranges without CDR and with and without CDR

w/o CDR (n=37)

Without CDR, less flexibility and more demanding near-term pathway, with many models unable to solve

w/ and w/o CDR (n=408)

Rose and Scott (2018)

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