Utilizing Expert Assessment to Inform Cost-Effective Energy R&D Investment Portfolios

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Introduction and Motivation

- Research Question: What is the optimal level and allocation of energy R&D funding?
  - R&D complements climate policy
  - Deep uncertainty makes R&D investments unique
- First, a method to estimate the ex-ante returns to R&D is required, taking into account:
  - The uncertain impact of R&D on technology performance
  - The uncertain benefits of improved technology performance
- DOE's organization does not facilitate cost-effective R&D decision making across technology areas. To be useful, a decision support tool must also:
  - Make technical assumptions transparent and easy to update
  - Calculate benefits in an integrated framework rather than technology-by-technology
- Integrated assessment models (IAMs) can be more effectively utilized in a decision analytic framework

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Methods

R&D Investment Allocation Scenarios

6 tech. areas: fossil, nuclear, PV, bioenergy, storage, vehicles

Distributions of Technology Cost Trajectories

extrapolations from samples of 2010 and 2030 elicited distributions

Economic/Environmental Outcomes under Climate Policy Scenarios

aggregate economic surplus and CO_2 emissions

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Expert Elicitation

6 sets of technology forecasts chosen to represent information sets of 100 experts, including an inter-technology dependence structure

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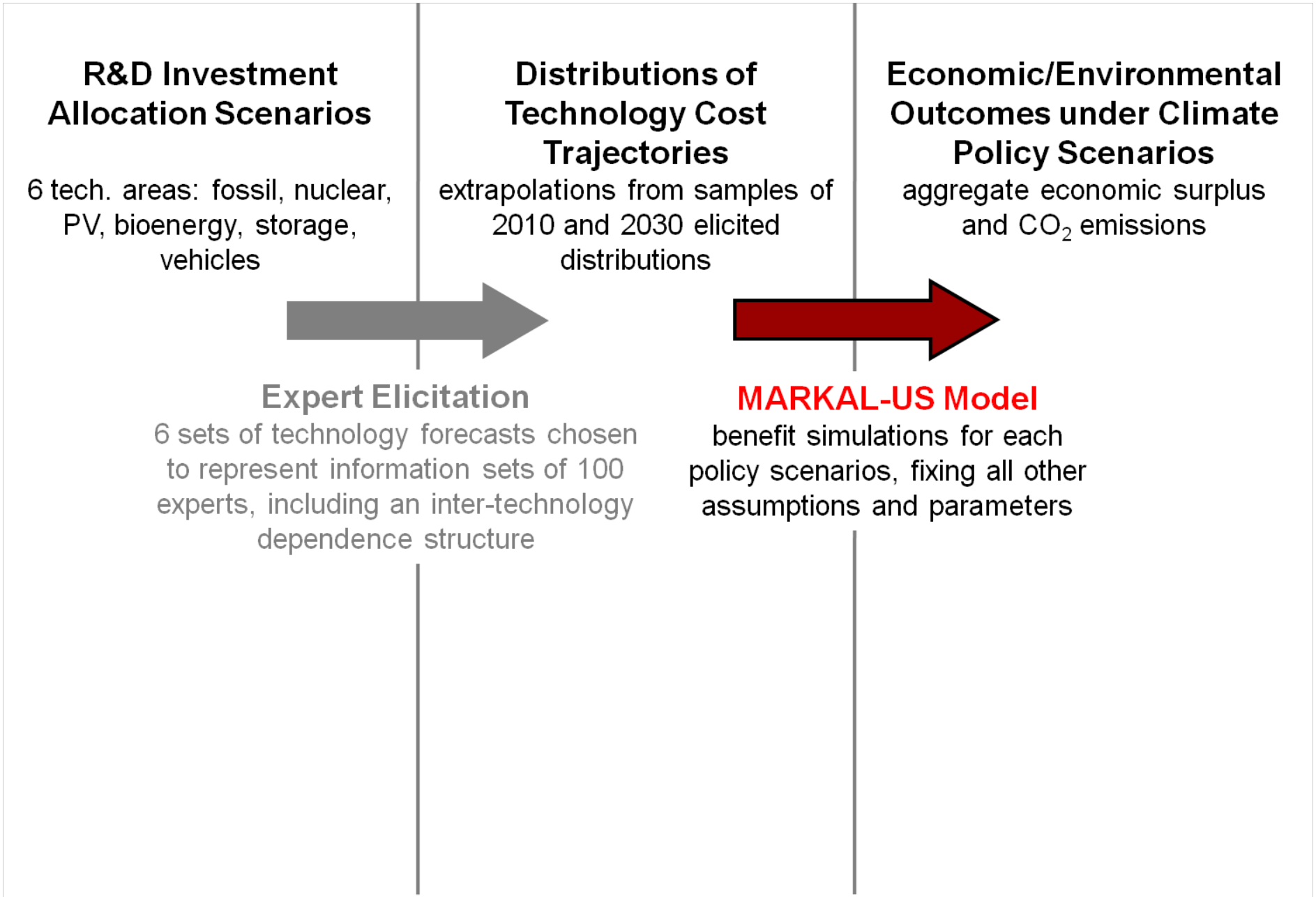
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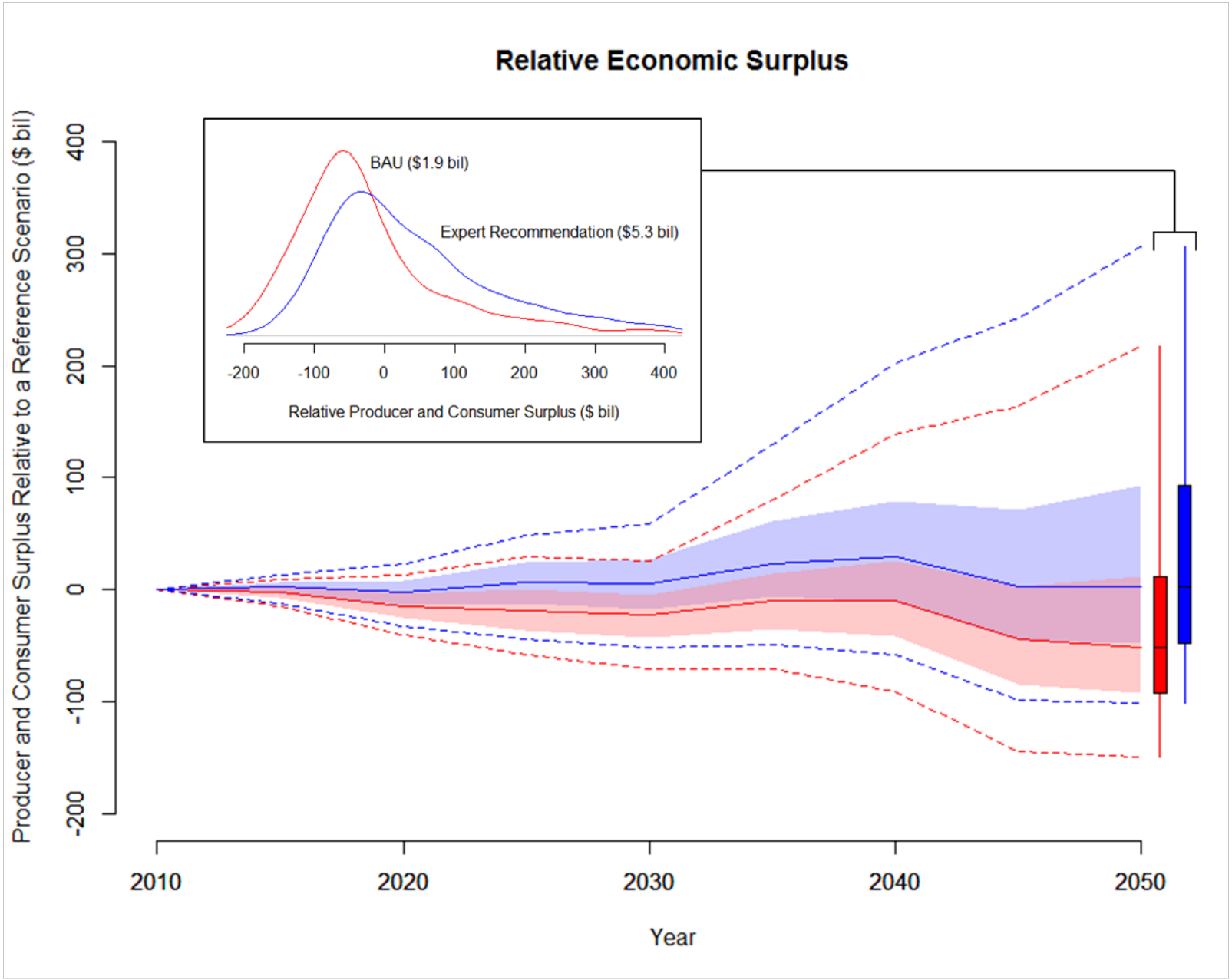
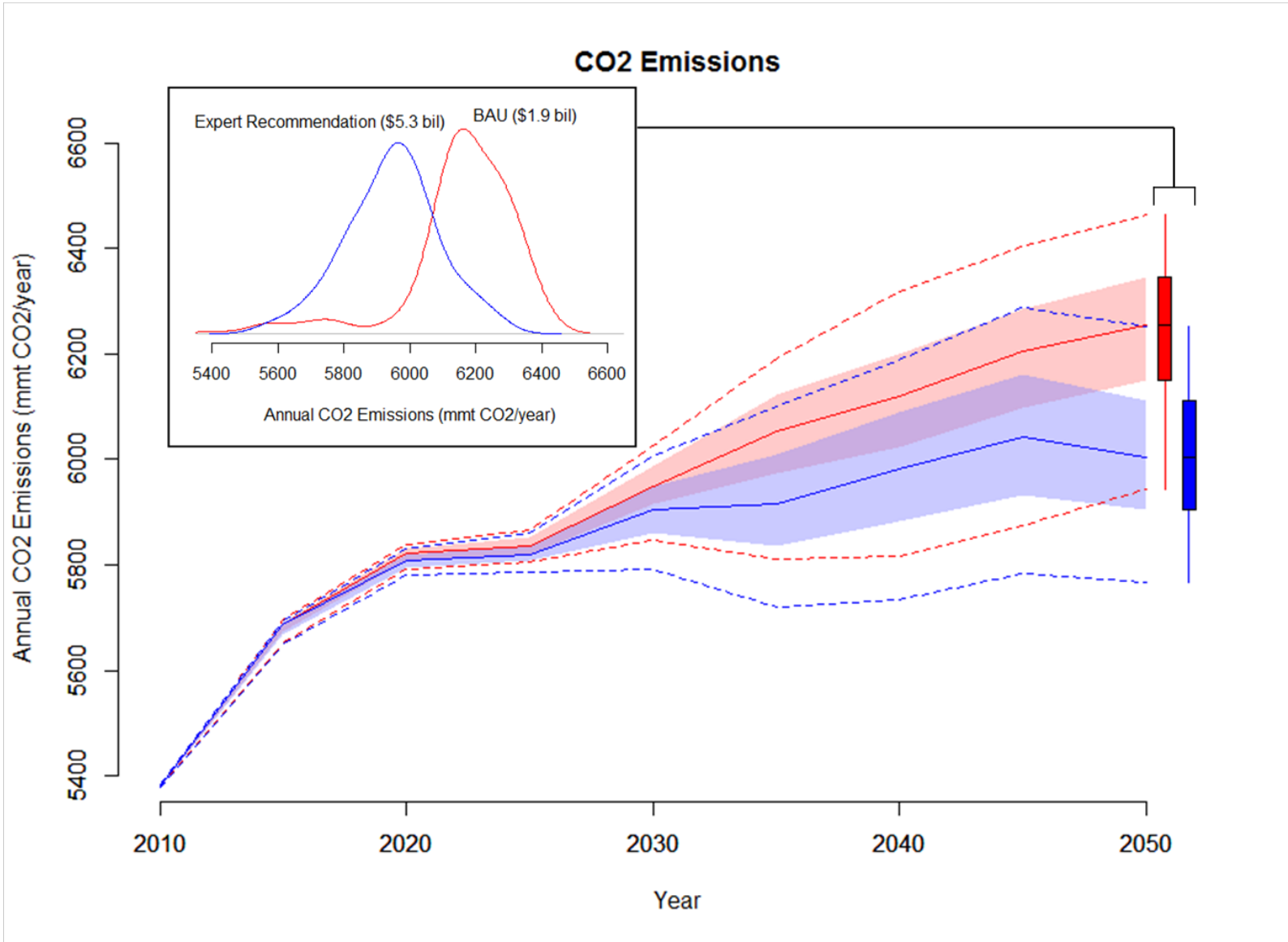
MARKAL-US Model
benefit simulations for each policy scenarios, fixing all other assumptions and parameters

Calculating the benefits of a single R&D portfolio



Calculating the benefits of a single R&D portfolio



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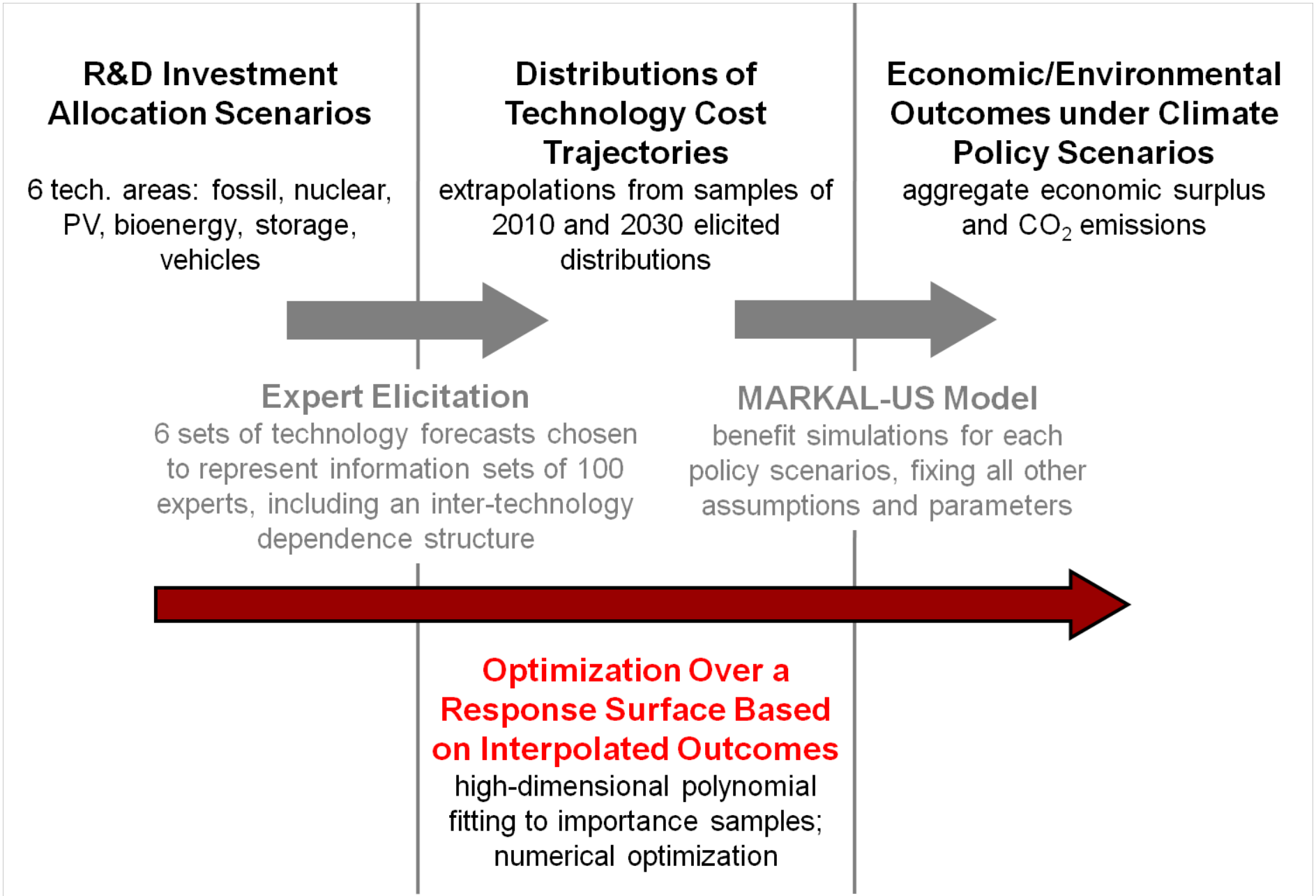
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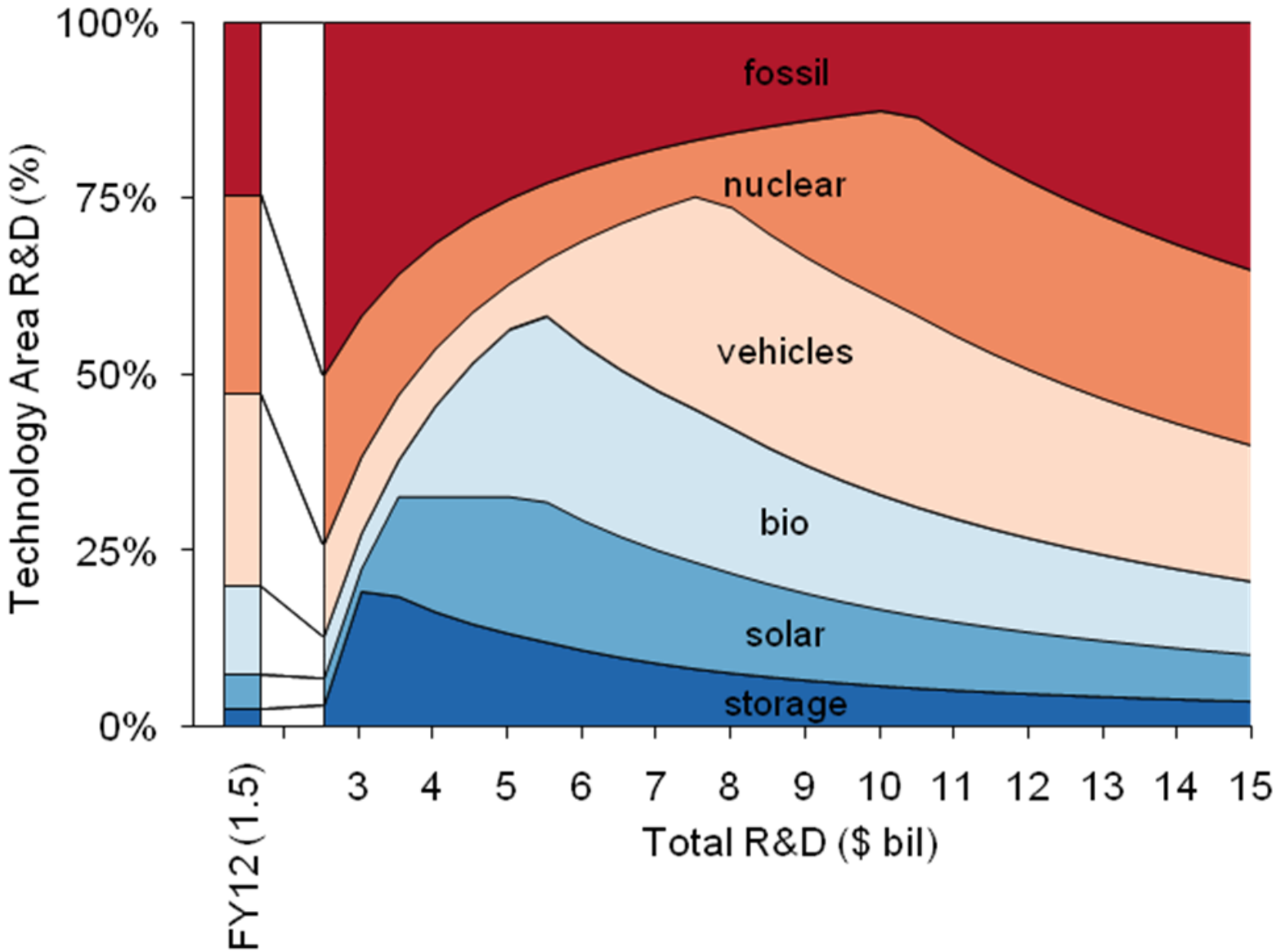
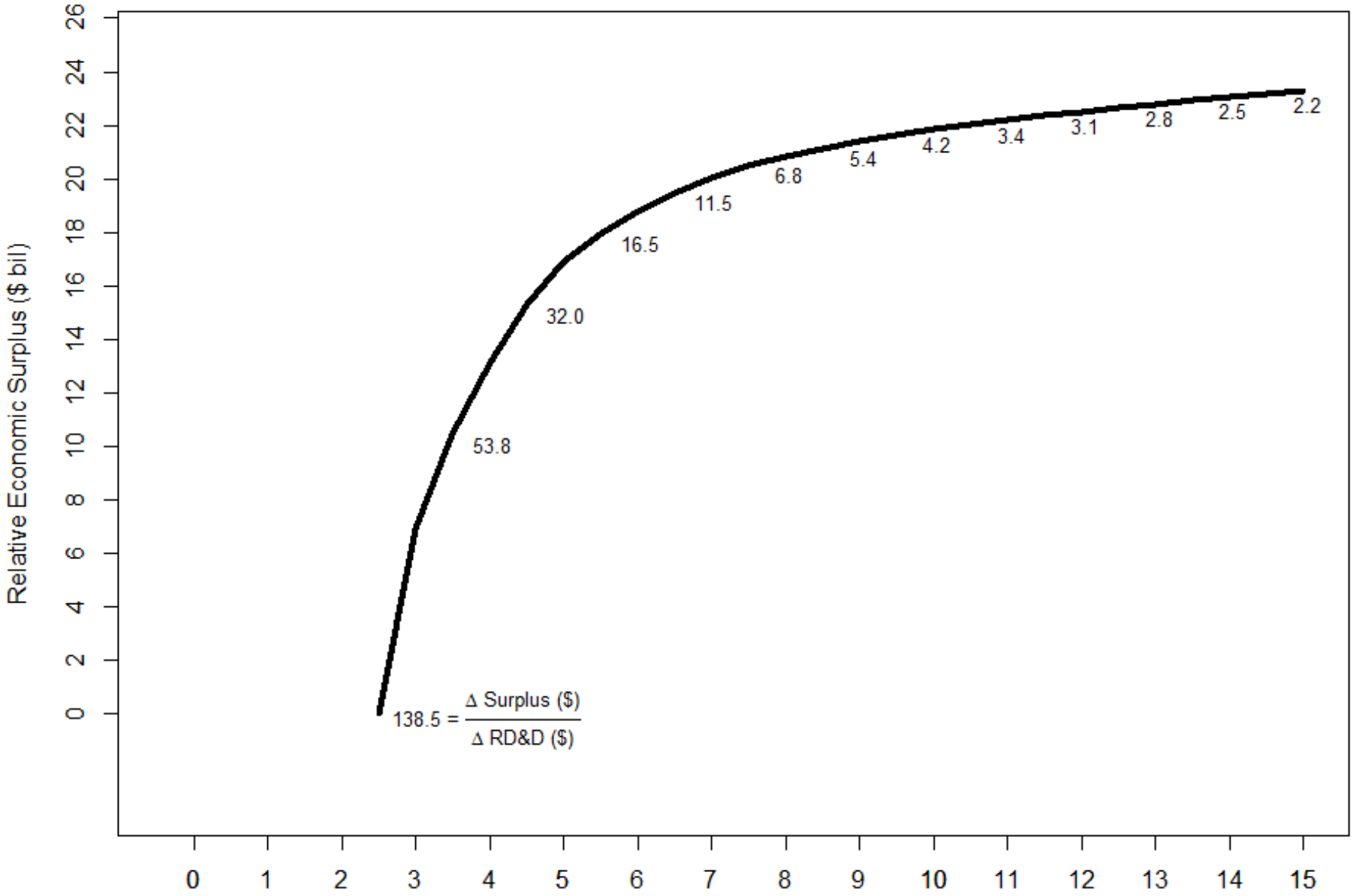
Optimization Over a Response Surface Based on Interpolated Outcomes
high-dimensional polynomial fitting to importance samples; numerical optimization

Optimal allocation of R&D investments



Optimal allocation and level of R&D investments



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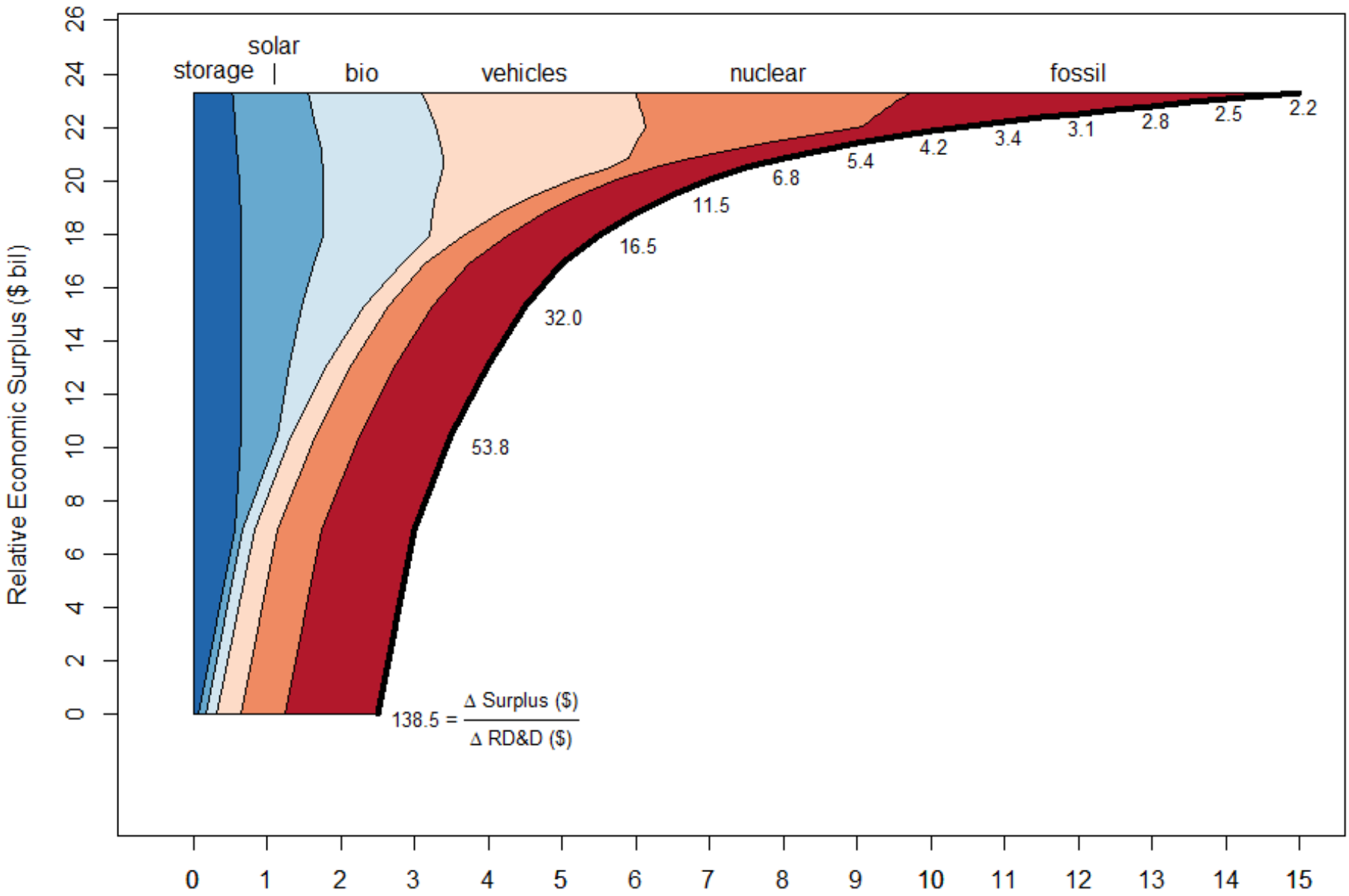

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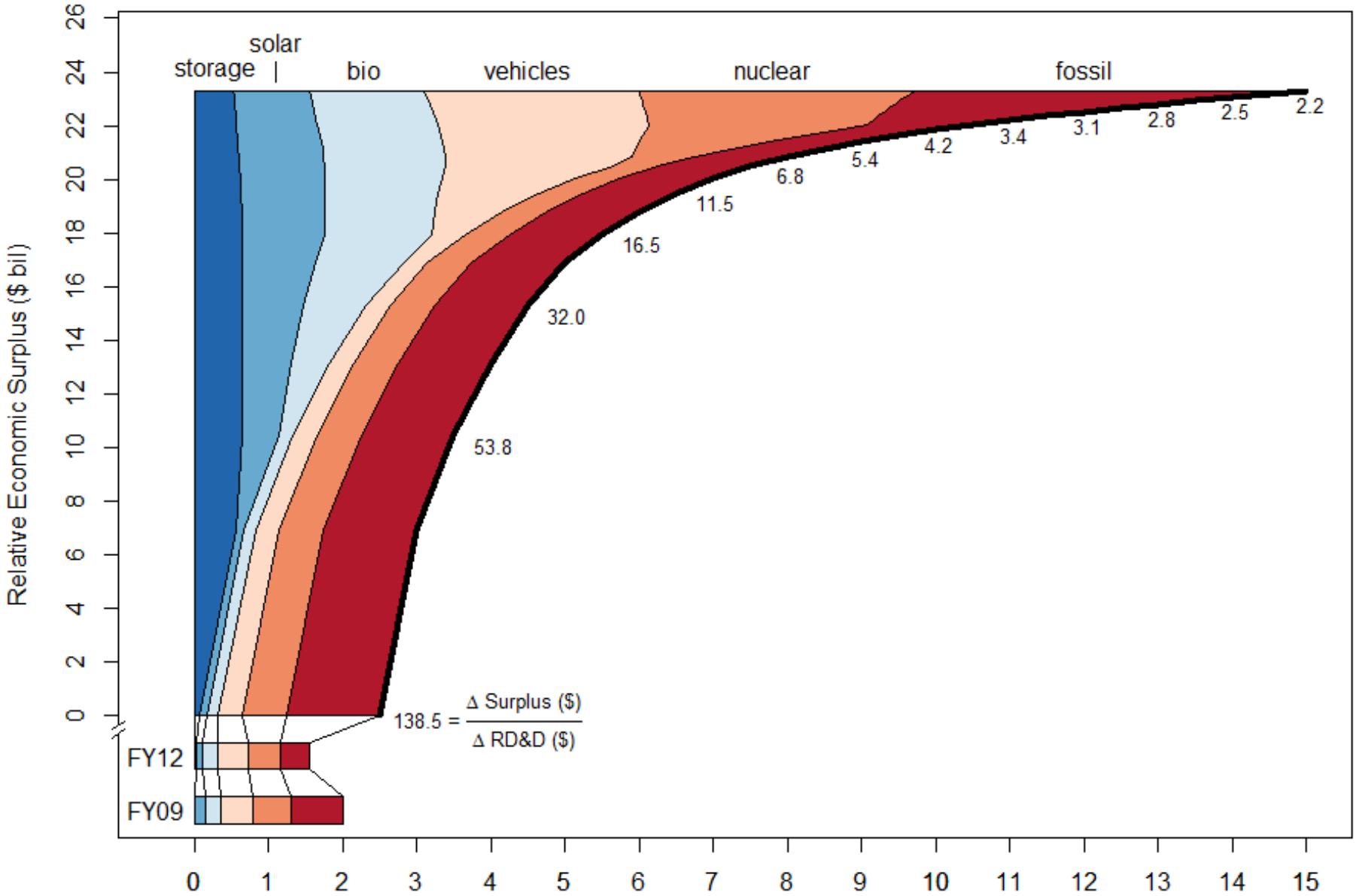

Discussion

- IAMs can be made more useful for policy makers by explicitly linking model inputs to intermediate technical policy outcomes
- Further work could model the R&D decision making problem as a multi-period repeated decision with learning. Other notions of optimality could be considered, especially with additional computational power
- This type of decision support tool has received strong interest from policymakers

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Thanks

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