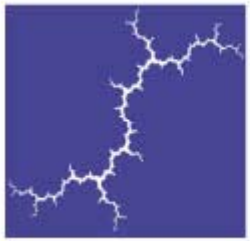

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Evaluating Simplified Methods of Estimating Displaced Emissions in Electric Power Systems

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Presented at:

Charting the Path Forward: Accounting for Renewables and the Environment
Washington DC, November 4, 2004

Common methods of estimating displaced emissions – short term

- System average emission rates
- Fossil system average emission rates
- Determine the “operating margin” during the appropriate hours
  - Use a power system simulation model (GE MAPPS, PROSYM, PROMOD)
  - Identify the appropriate marginal emission factors based on other analyses

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Common methods of estimating displaced emissions – long term

- System average emission rates
- Fossil system average emission rates
- Determine the “build margin”
  - Use a capacity expansion model (NEMS, IPM).
  - Make educated guess about what type of units are likely to be added and retired in the relevant system.

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Where we are now?

- Consensus emerging that use of a system average is not appropriate. (??)
- Concern that modeling is resource intensive and not transparent enough.
- Growing interest in evaluating other non-modeling based methods.

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How well does the method capture the *important* aspects of system operation?

- Matching generation to load hour to hour,
- The effect of transmission constraints and unit outages on the available set of generators, and
- Capacity additions and retirements over the longer term.

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Three non-modeling based methods have been explored

- Defining the marginal unit(s) based on geography.
- Defining the marginal unit(s) based on unit type, and
- Defining the marginal unit(s) based on a load curve analysis.

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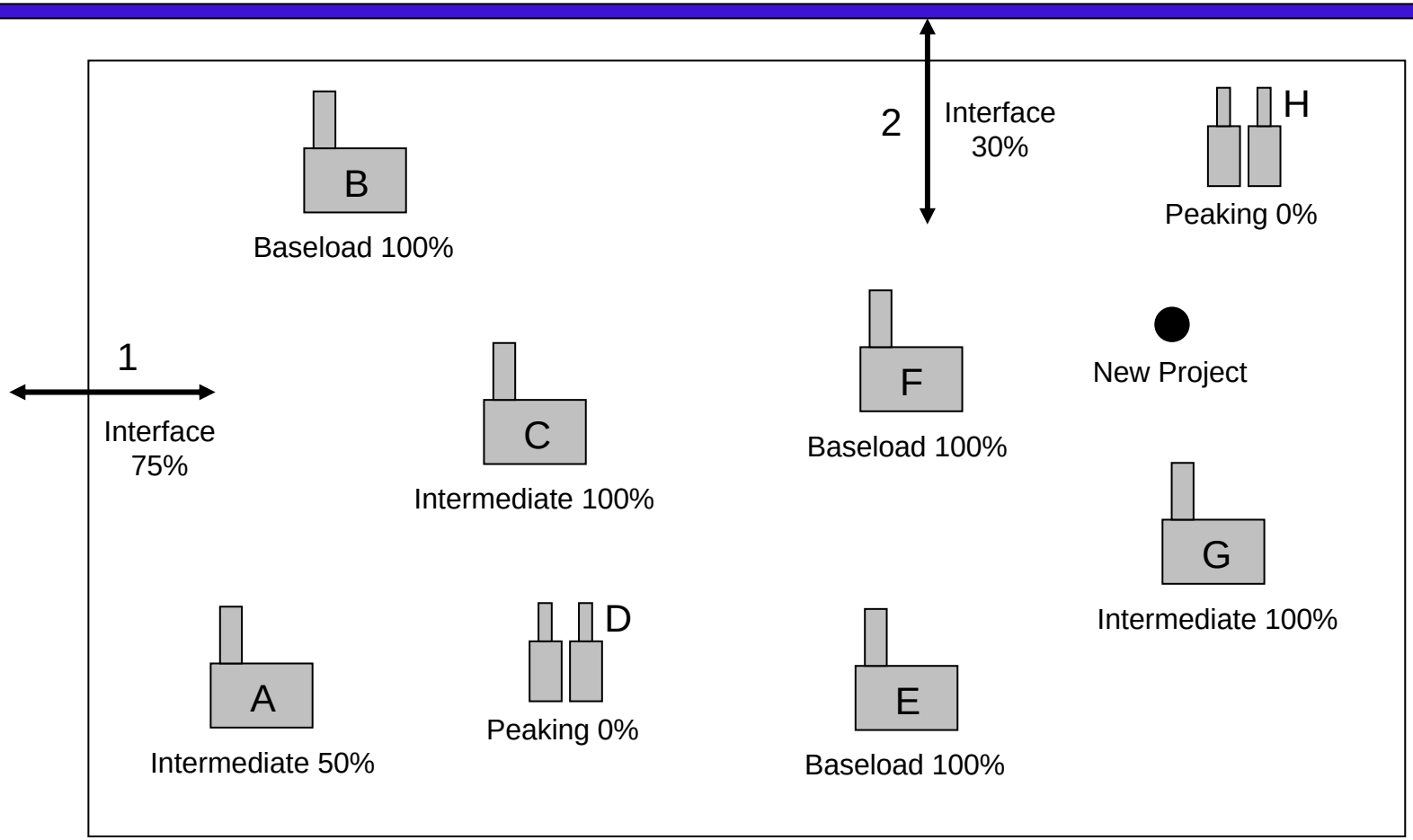
One cannot reliably identify marginal unit(s) based on geography.



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One cannot reliably identify marginal unit(s) based on unit type.

- Its not always "*peaking*" units: different unit types are on the margin during different hours of the day and different seasons.
- New resources affect "*load following*" units but not in a predictable way or a systematic way.

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Load curve analyses are promising

1. Develop a load duration curve.
2. “Stack” resources under the curve in the order in which they are typically dispatched.
3. Calculate weighted average marginal emission rates based on marginal units.
4. Apply these emission rates to the energy generated by the new renewable unit.

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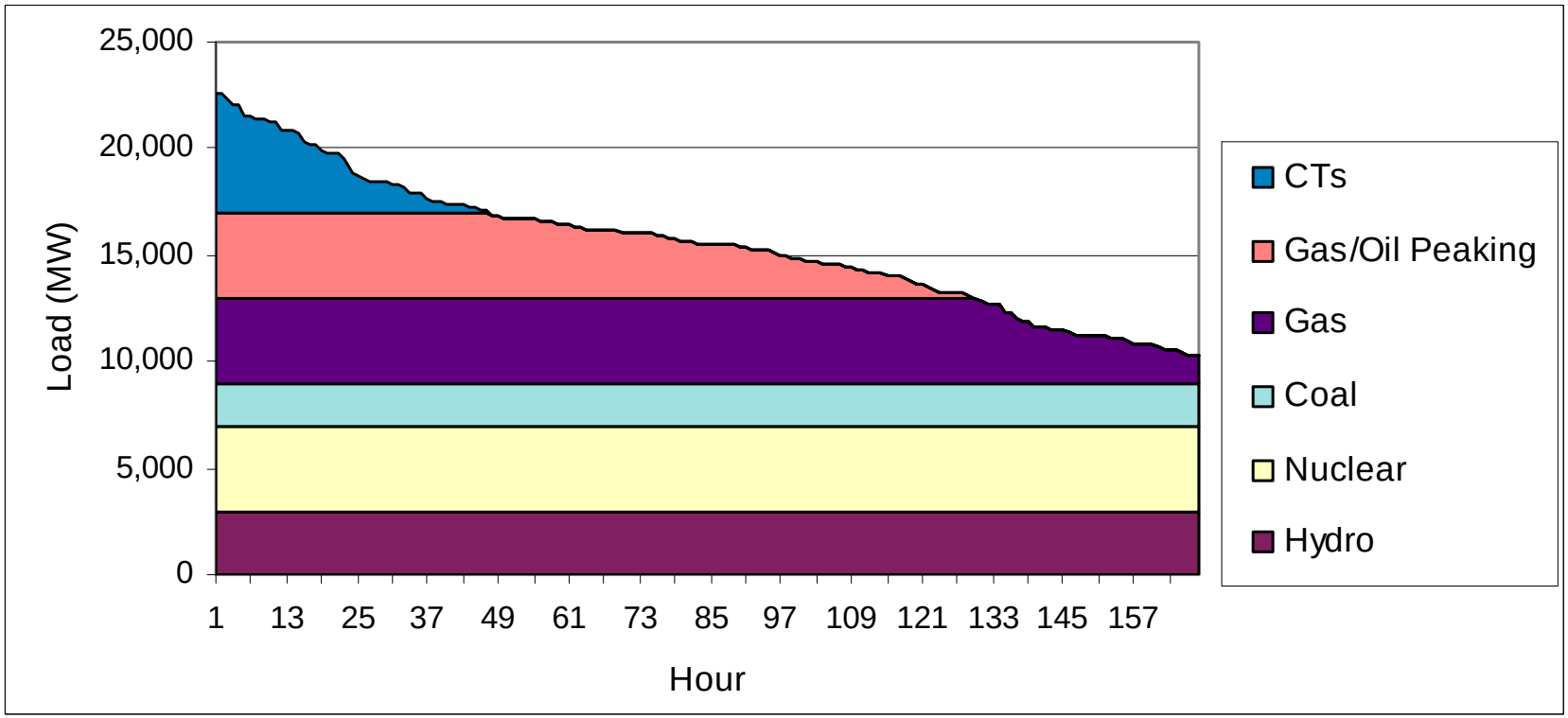
Load Duration Curve with Simplified Dispatch Data



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But there are important questions about load curve analyses

- Data must be adjusted to fit under the load curve.
- Where do you put power purchased from out of the region (and how do you characterize its emissions)?
- Load curve analyses ignore transmission constraints and their impacts on unit dispatch.

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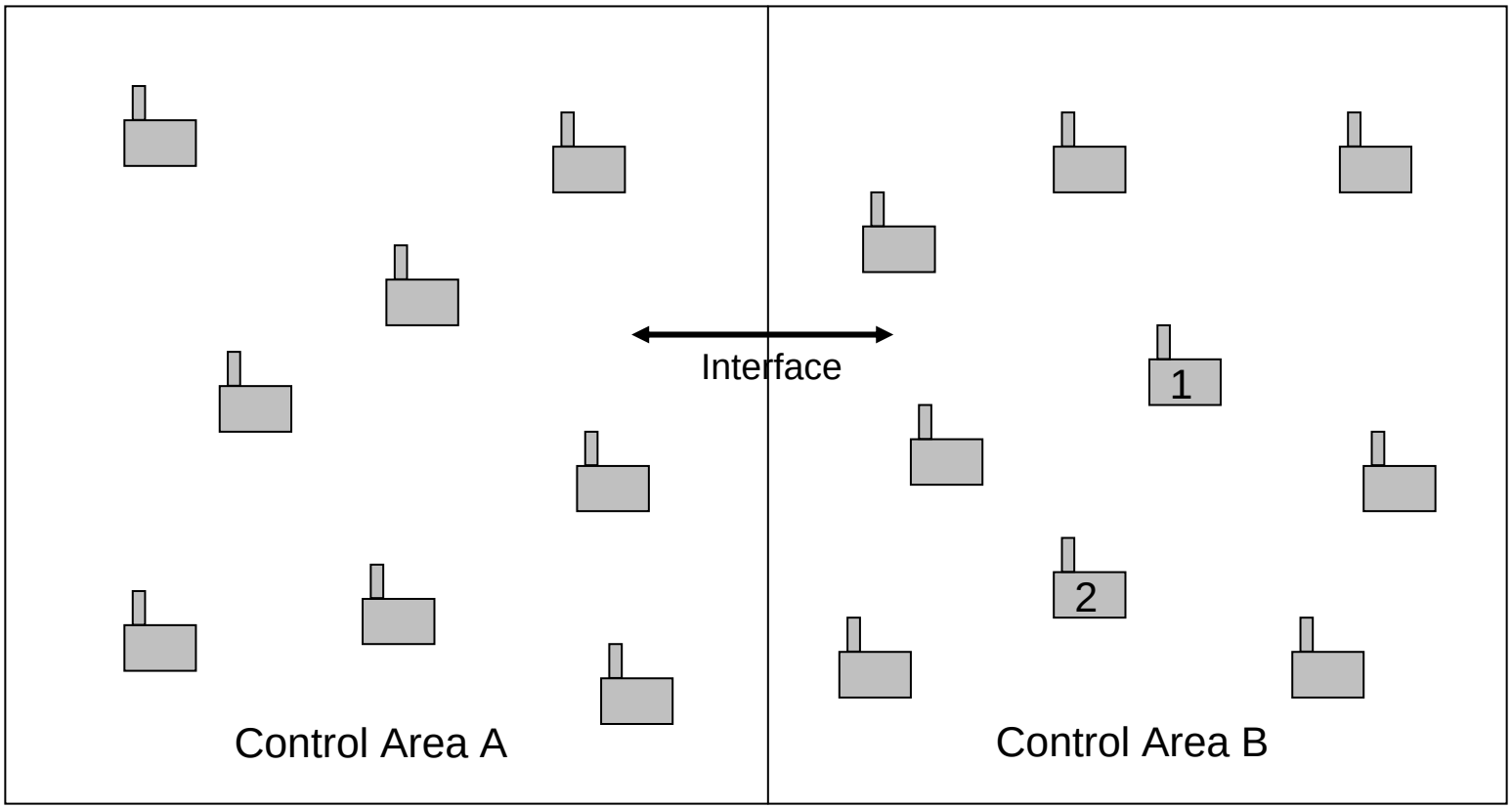
Transmission constraints affect the available set of generating units



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Conclusions

- One cannot reliably identify marginal unit(s) based on geography or unit type.
- Load curve analyses are a better approach, but more work is needed to determine how robust they are.
  - Do the adjustments necessary in fitting capacity under the curve compromise the method?
  - Can purchased power be accounted for effectively?
  - How much does transmission matter in unit dispatch?

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