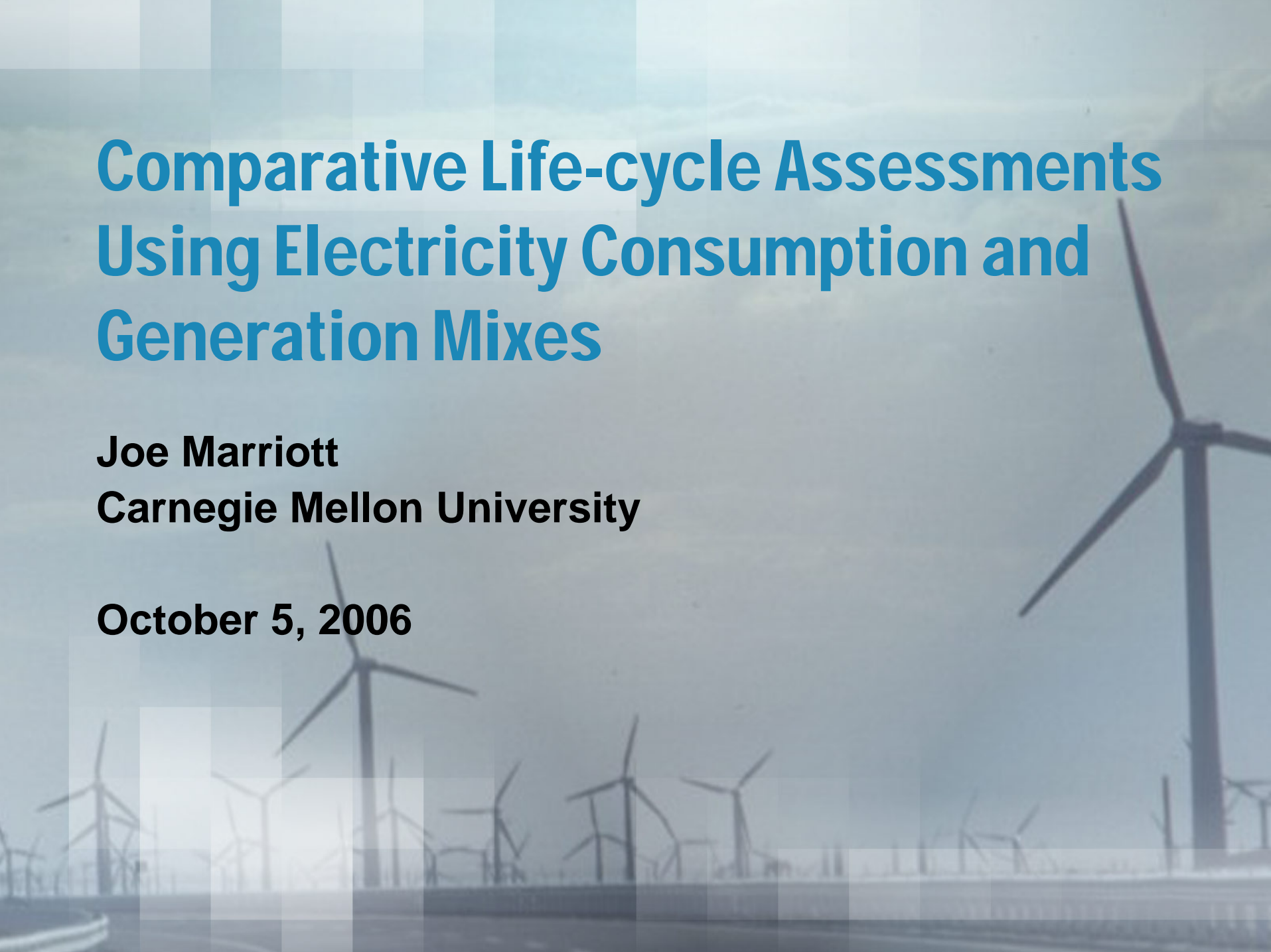


Comparative Life-cycle Assessments Using Electricity Consumption and Generation Mixes

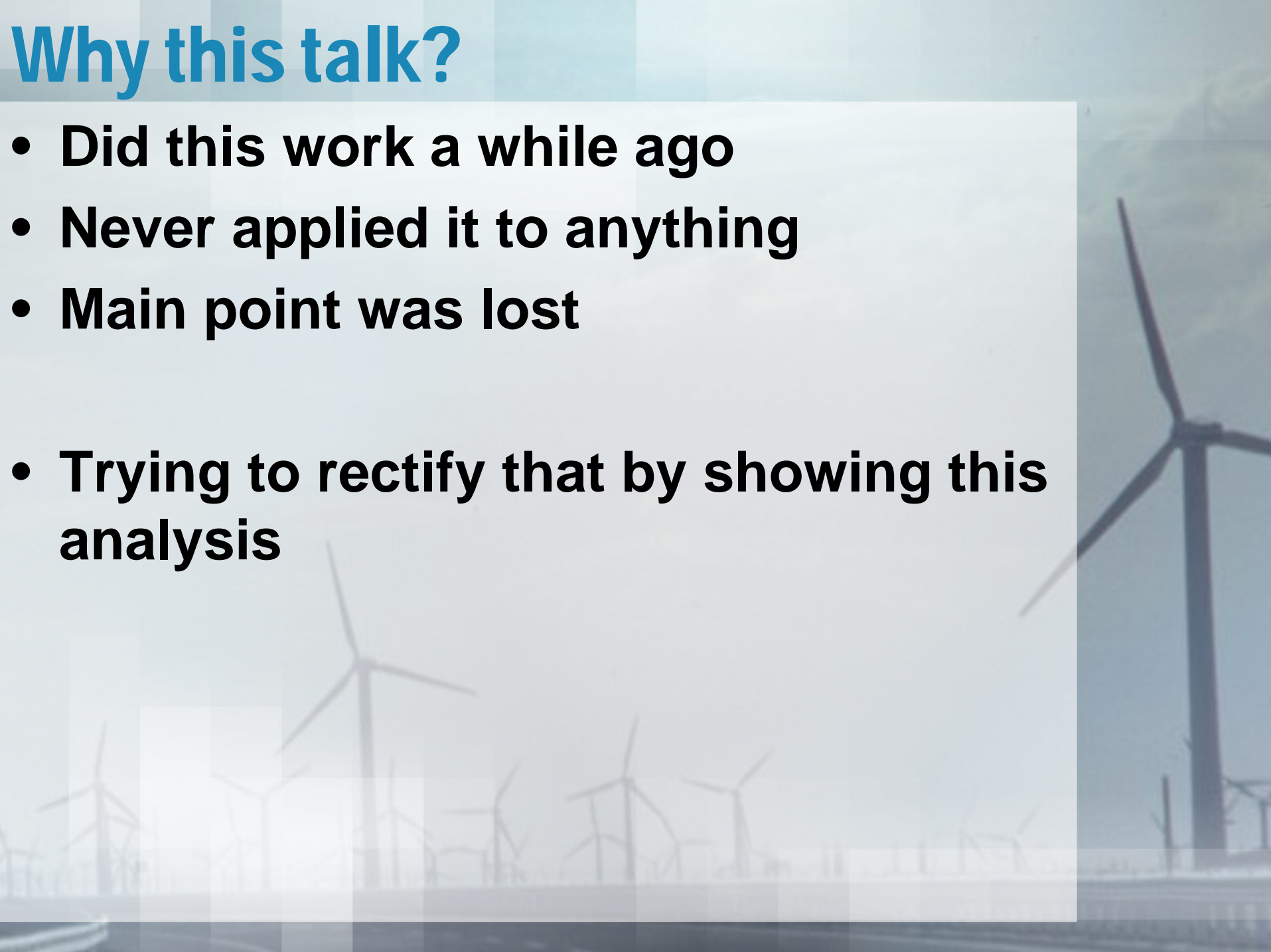
**Joe Marriott
Carnegie Mellon University**

October 5, 2006



Why this talk?

- **Did this work a while ago**
- **Never applied it to anything**
- **Main point was lost**
- **Trying to rectify that by showing this analysis**



Electricity is a big deal, redux

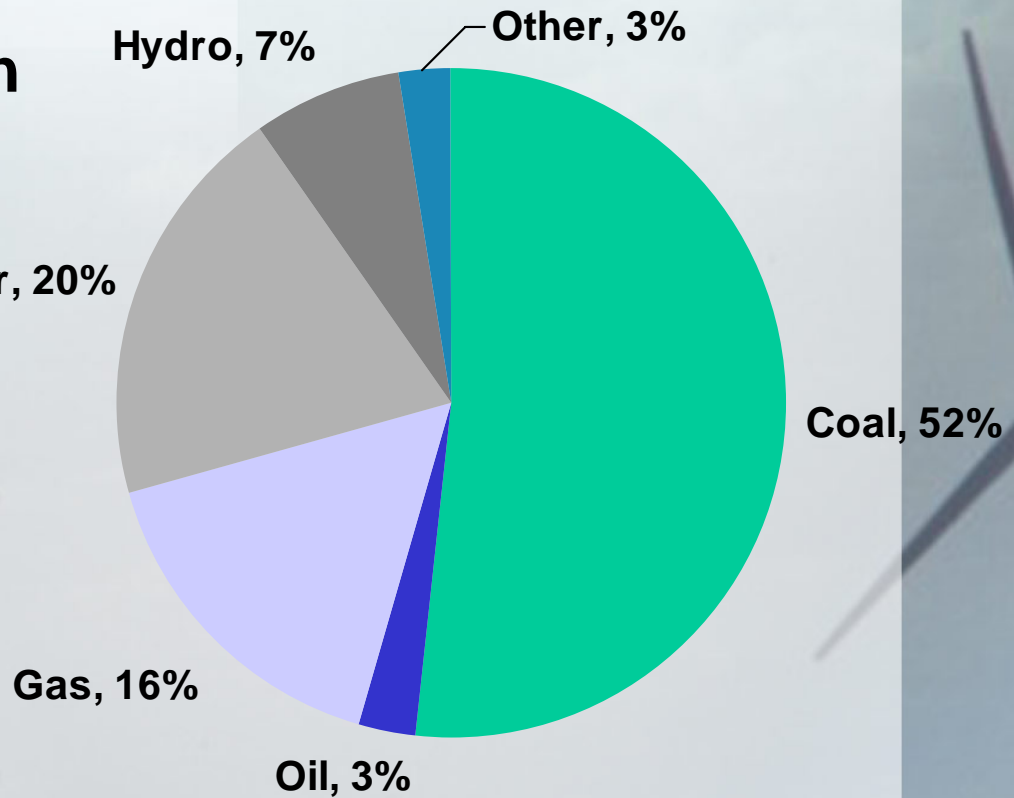
- **Economically**
 - 4% U.S. GDP, about \$300 billion
- **Environmentally**

	\$	GWP
Coal mining	1.3%	6.3%
Aircraft mfct	0.6%	27.7%
Semiconductor mfct	0.8%	29.1%
Wineries	0.7%	37.7%
Primary aluminum	6.1%	48.2%

“Poor” Electricity Assumptions in LCA

- Average US generation mix is used to estimate emissions, GWP, health and environmental impacts

- Many products, processes & industries have consumption profiles which are very different from the average



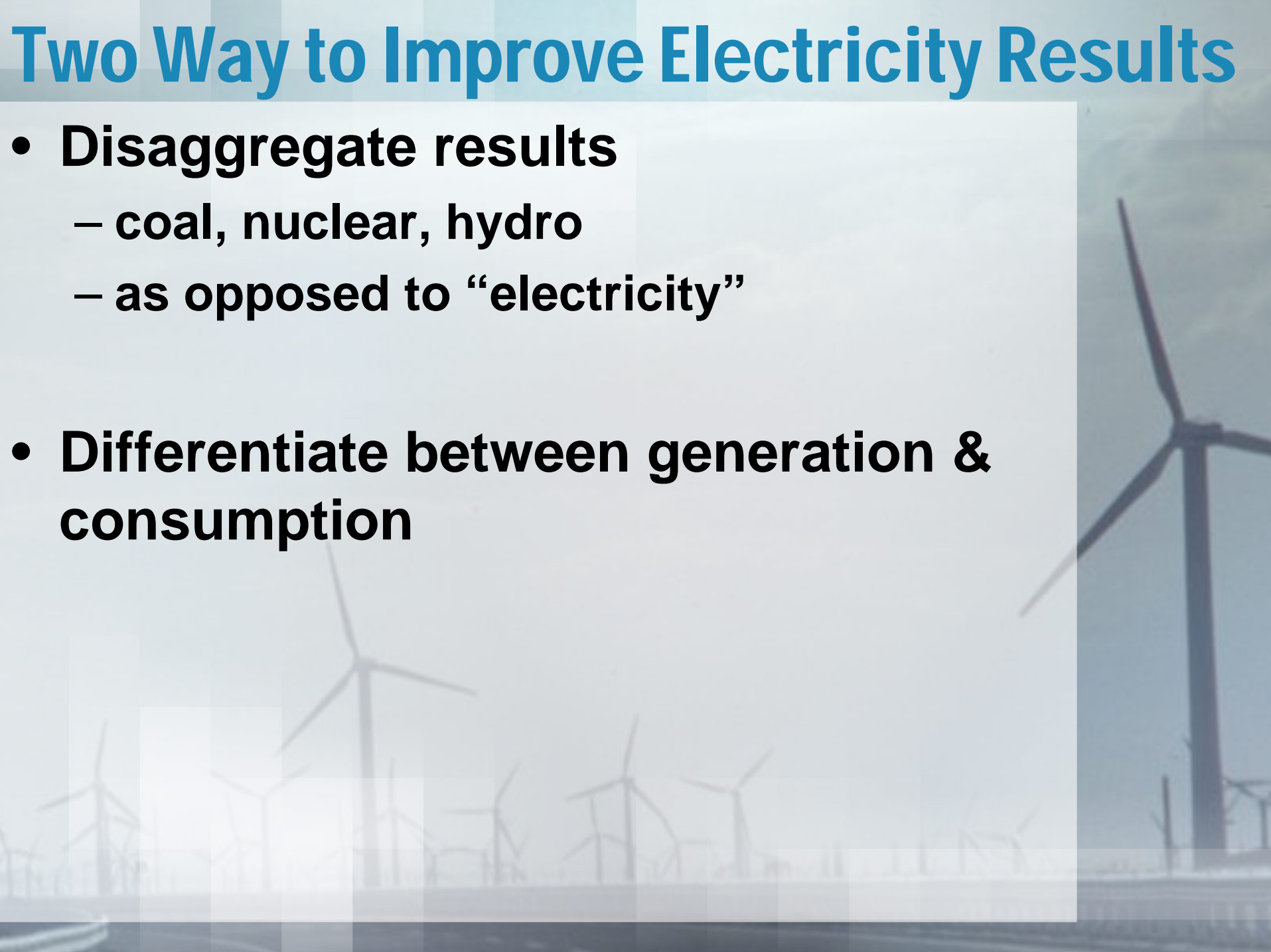
Results of “Poor” Electricity Choices

- **Impacts by generation type vary widely**
 - Coal vs. gas vs. hydro vs. nuclear vs. wind, etc.
- **This variation should be reflected in environmental assessments to ensure accurate reporting of impacts**
- **For example: Aircraft manufacturing**
 - Industry sector has emission numbers reduced due to plants in NW, which has 80% hydro generation (and a corresponding increase in ecosystem disruption)



Two Way to Improve Electricity Results

- **Disaggregate results**
 - coal, nuclear, hydro
 - as opposed to “electricity”
- **Differentiate between generation & consumption**

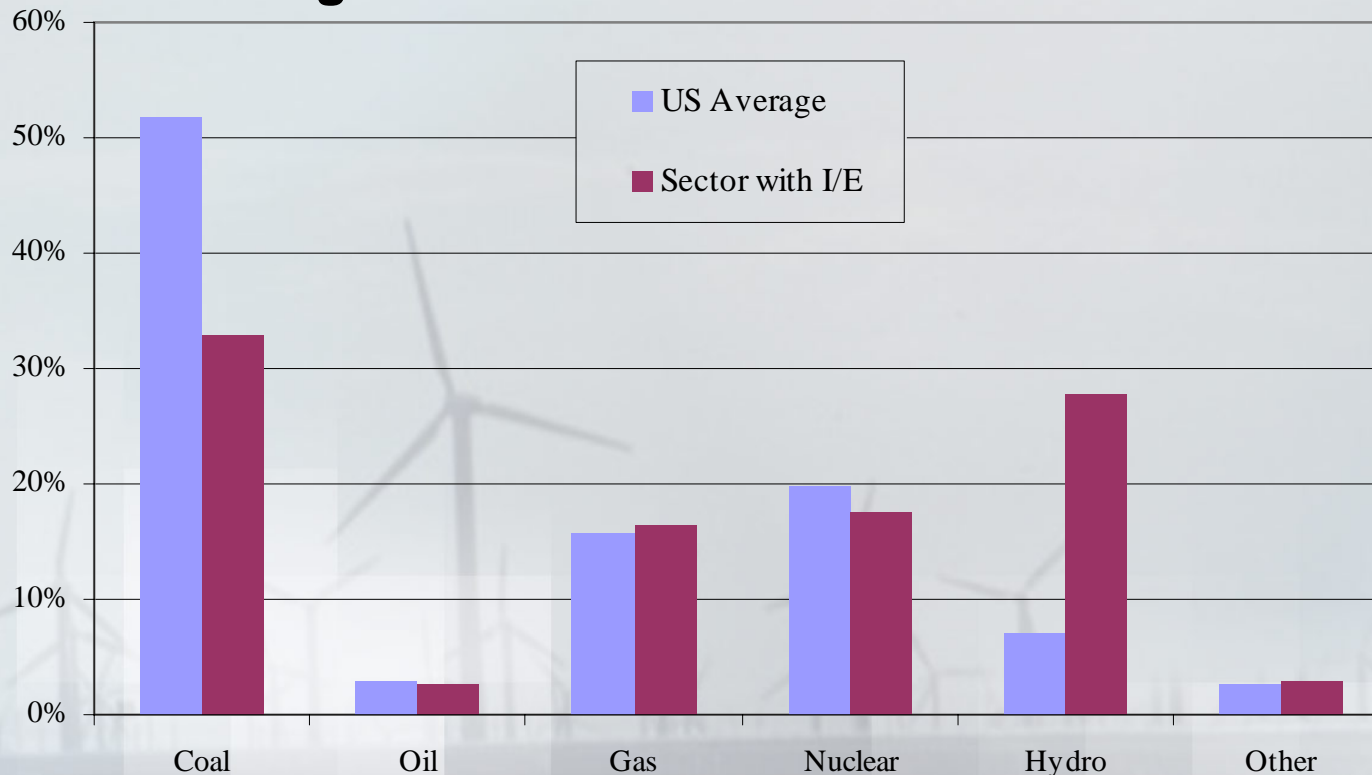


Disaggregate Results

- If we know where industries are located, and how the electricity was generated in different regions, we can make more educated guesses

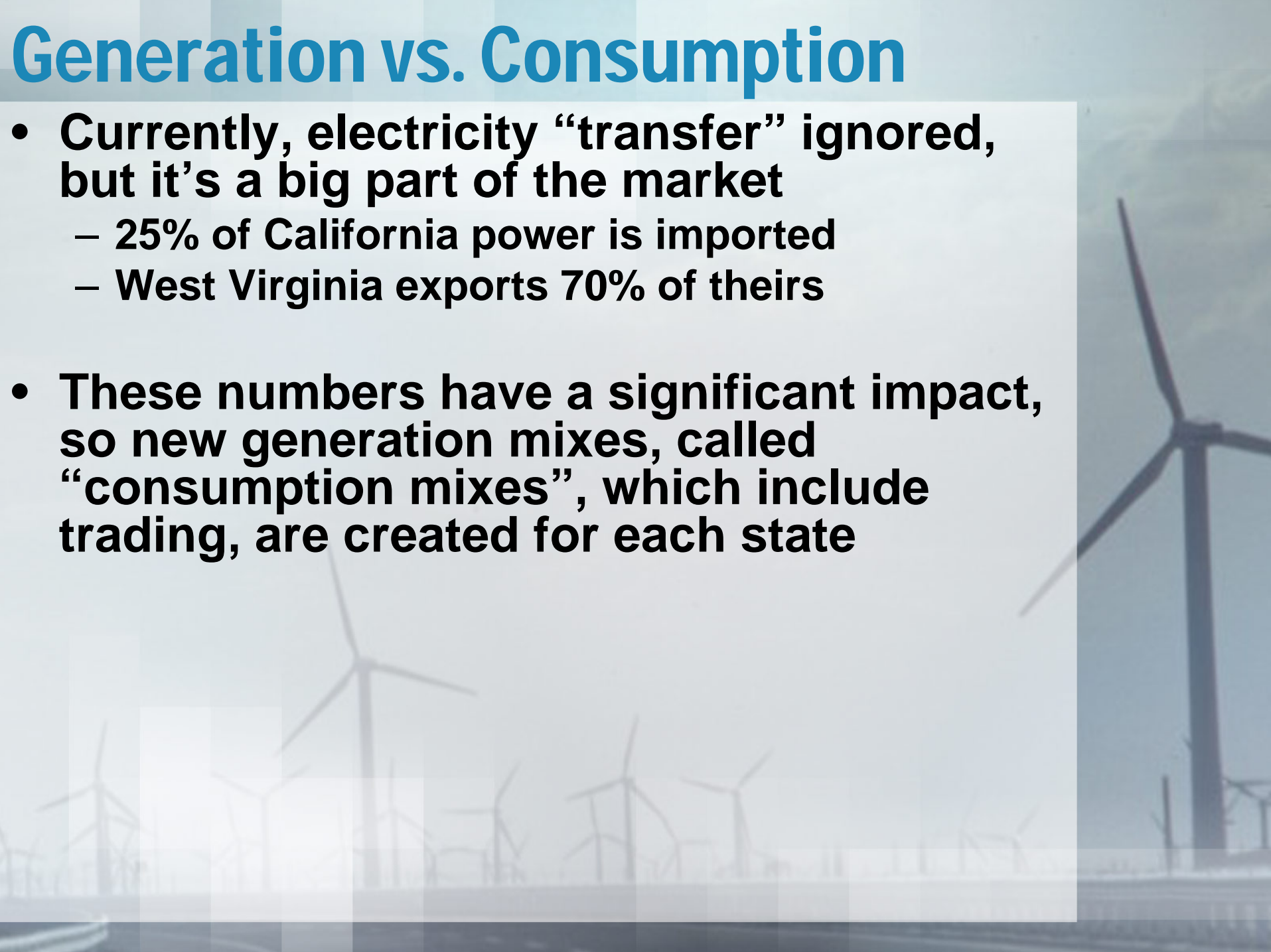
We have both:

- “Locations” of industry sectors from BEA
- State generation mixes from EPA

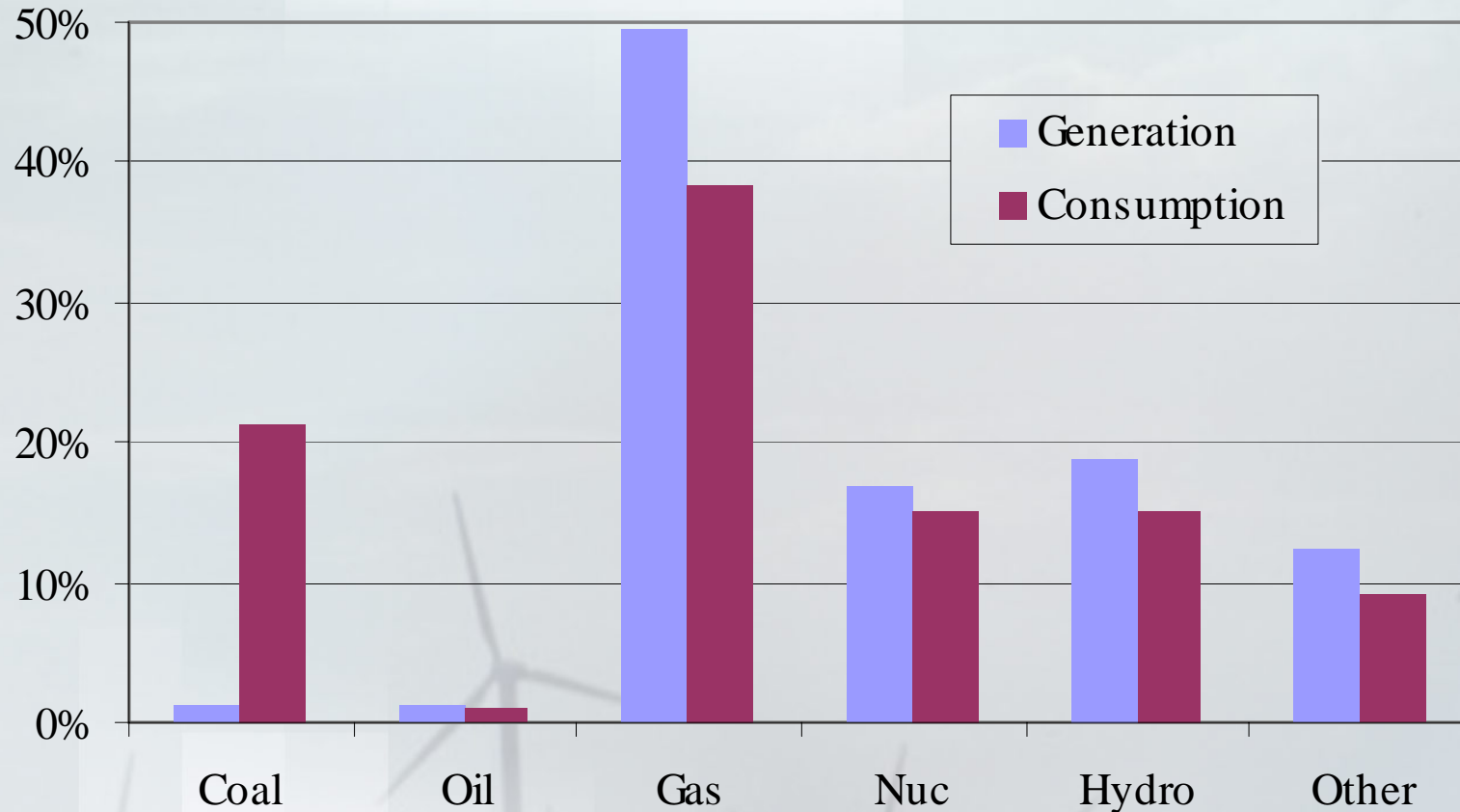


Generation vs. Consumption

- **Currently, electricity “transfer” ignored, but it’s a big part of the market**
 - 25% of California power is imported
 - West Virginia exports 70% of theirs
- **These numbers have a significant impact, so new generation mixes, called “consumption mixes”, which include trading, are created for each state**



The California Consumption Mix



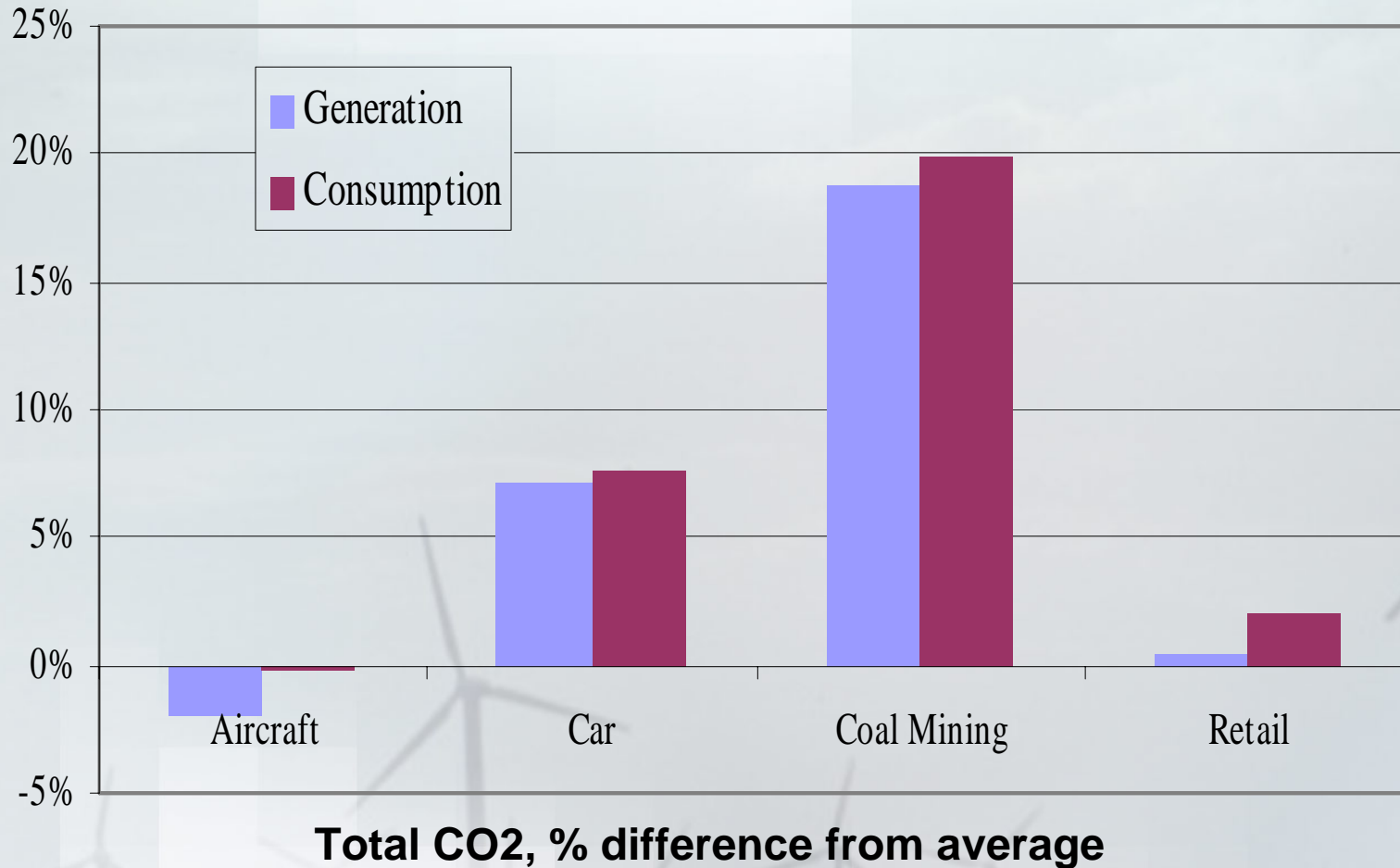
Do these improvements matter?

- **It depends**
- **In many cases, disaggregate results look like US average anyway**
 - In LCA, the larger the boundaries, the more averaging happens
- **But, not all the time**
 - In some major (primary) sectors, disaggregate results and gen/con assumptions matter

Comparative LCAs

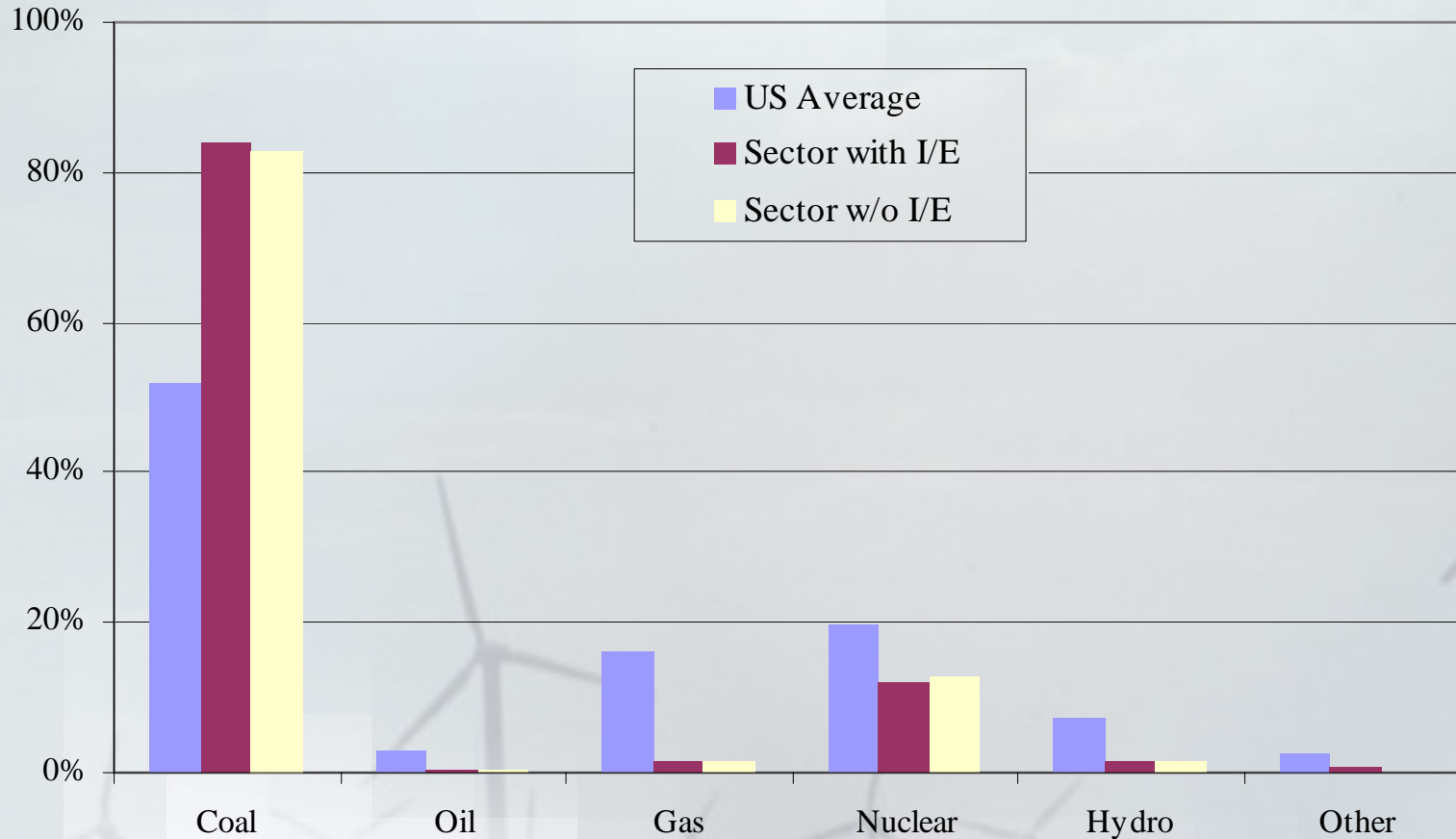
- **Modeled in EIO-LCA**
 - **\$50K car**
 - **\$35K “Automobile Mfct” purchase**
 - **\$220M Boeing 777**
 - **\$155M “Aircraft Mfct” purchase**
 - **\$1M Coal**
 - **“Coal Mining”**
 - **\$1M Retail**
 - **“Retail Trade”**
- **2 runs for each: \$, CO₂ only**
 1. **Disaggregate Generation**
 2. **Disaggregate Consumption**
 - **Compare to normal (average) results**

LCA CO₂ Results



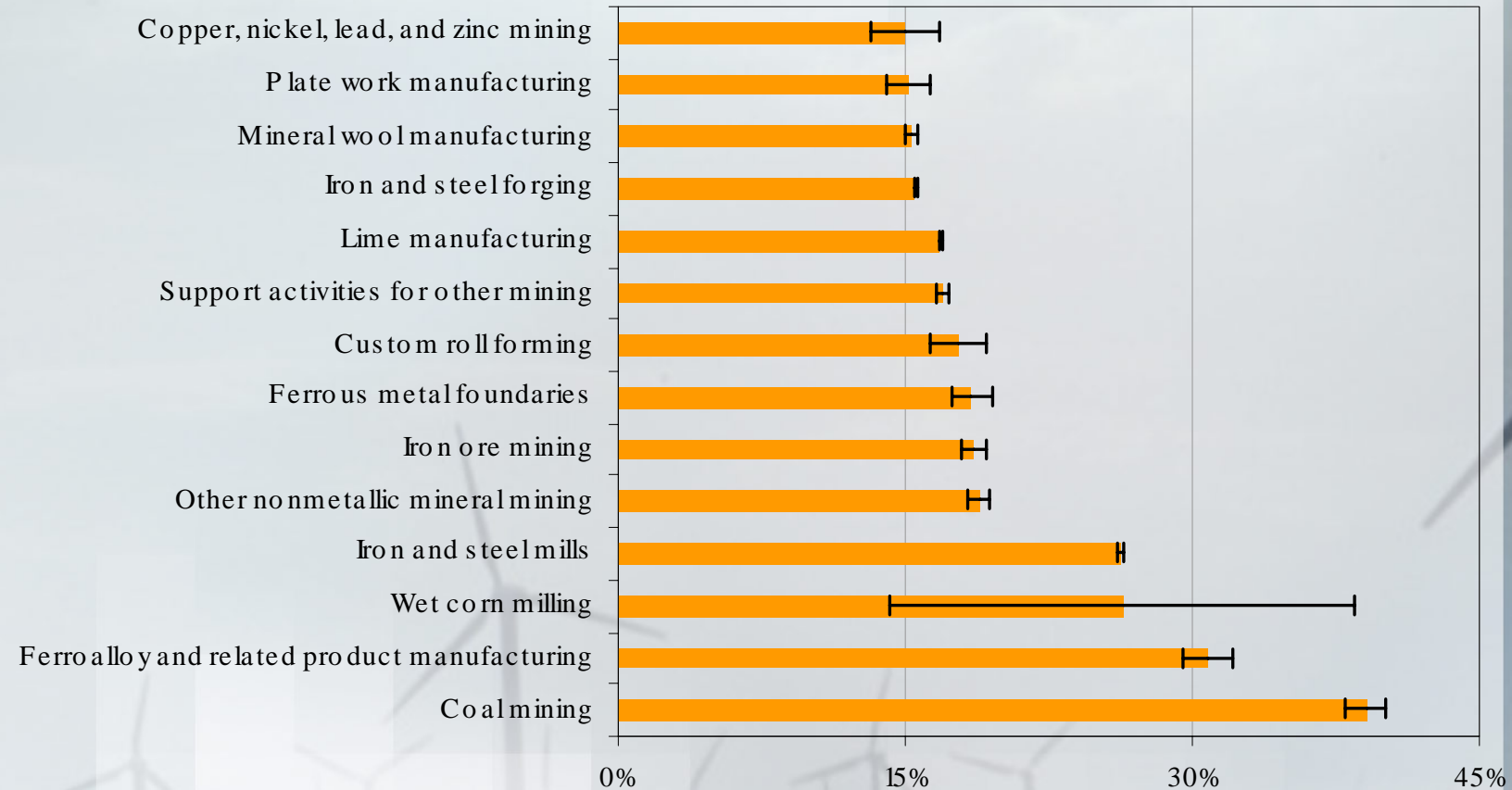
Coal Mining is Coal Intensive

2121 Coal Mining



Not just coal mining...

- Other primary industrial sectors are different



Disaggregated Total PG&S CO₂, as % difference from average U.S. generation

Conclusions

- **Exact results, i.e. tons of CO₂, aren't particularly important**
 - It's the relative values which matter here
- **Same as before, but now with additional LCA evidence:**
 - **Electricity is important**
 - Disaggregation and “consumption” helps
 - **Doesn't always matter**
 - Matters enough of the time, and with important enough sectors that “electricity” shouldn't be treated as a homogeneous commodity

