Integrated Assessment for Global Climate Change

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A typical integrated assessment model contains submodels governing:

energy-related emissions

non-energy emissions

the domestic and international economy

global climate change.

Time horizon: 2100 or beyond. Importance of the discount rate. Prescriptive vs. descriptive views.

Outline

- BAU (business as usual) vs. control scenarios (e.g., stabilize temperature)
- policy questions and political issues
- algorithm issues
- general equilibrium applications with Negishi weights
- alternative algorithms for LBD (learn-by-doing)

The following figures are based upon the website:

www.stanford.edu/group/MERGE

There is full flexibility for abatement wrt:

- "when" - time periods
- "where" - regions
- "what" - greenhouse gases

Figure 1. Global carbon emissions

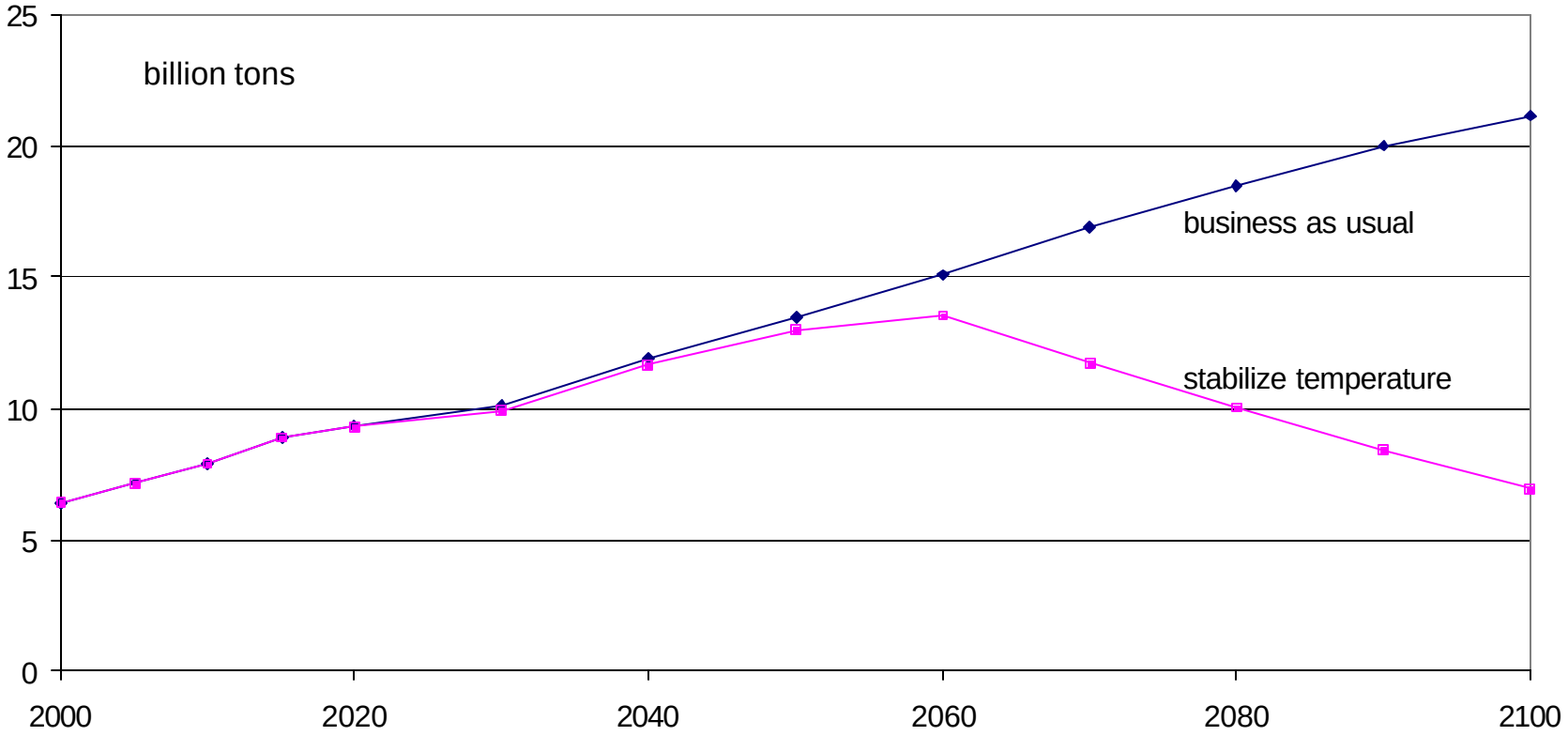
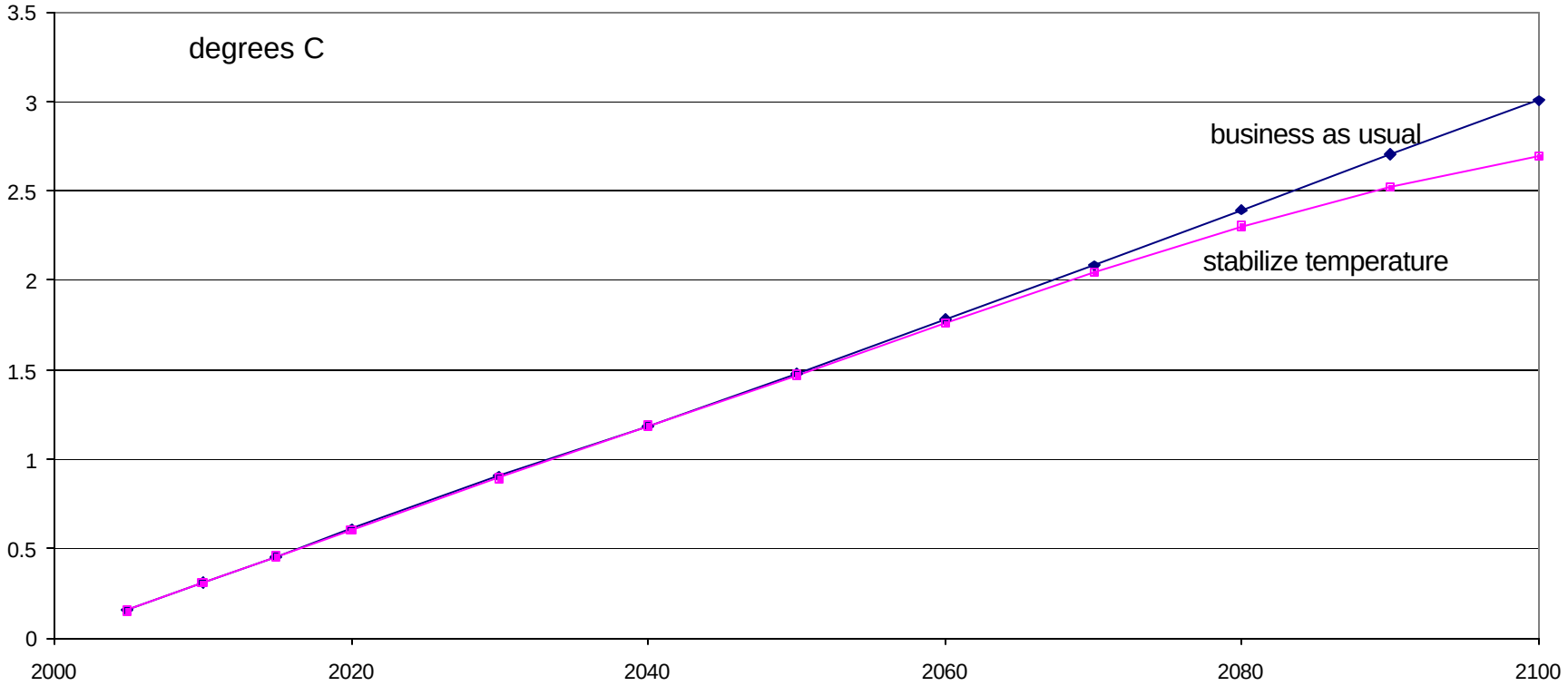


Figure 2. Mean global temperature - increase from 2000



Policy implications:

- To minimize global cost of stabilization, smooth departure from BAU emissions.
- Because of climate time lags, the realized temperature change differs even more gradually from BAU.
- Minimum cost depends on full “when”, “where” and “what” flexibility.

Policy questions and political issues

- equity vs. efficiency
- intergenerational tradeoffs
- “messy” nature of negotiated agreements, e.g. Kyoto Protocol of 1997

Algorithm issues

- Integrated assessment models can push the envelope for large-scale, convex, nonlinear optimization. Discounting can make things ugly.
- There are now about 30,000 single variables and 1,600 nonlinear, non-zero elements in MERGE.
- Currently using CONOPT3.
- For LBD (“learn-by-doing”), we have resorted to a heuristic.

General equilibrium applications with Negishi weights

- With multiple agents, we avoid assumption of a single, global optimum.
- Each agent's Negishi weight represents its equilibrium value share of global resource endowments.
- For a given set of Negishi weights, we solve a conventional nonlinear optimization problem.
- A GAMS loop makes it straightforward to revise these weights, and to ensure that each agent satisfies its budget constraints.

Alternative algorithms for LBD (learn-by-doing)

- Mixed integer programming
- BARON
- Dynamic programming
- Heuristics