

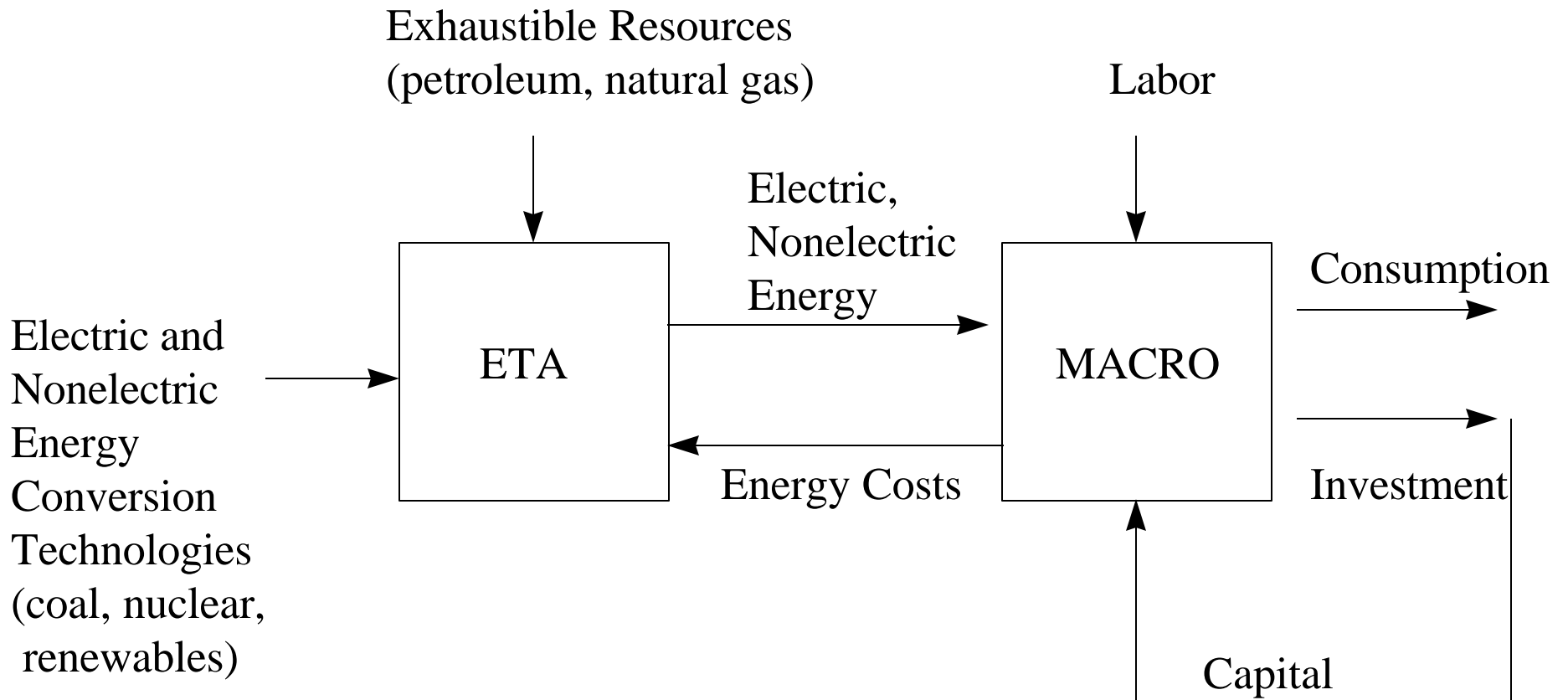
Energy Technology Assessment in MERGE

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An Overview of ETA-MACRO



Nonelectric energy technologies

#gas - 1,2,3,4

natural gas production at alternative cost levels

#oil - 1, 2, 3, 4

oil production at alternative cost levels

#coal

coal production

*cldu

coal - direct uses

synf

synthetic fuels derived from coal, shale
or tar sands

*renew

renewables - low cost

ne-bak

nonelectric backstop - high cost

Exhaustible resources

* Year-by-year supplies are limited

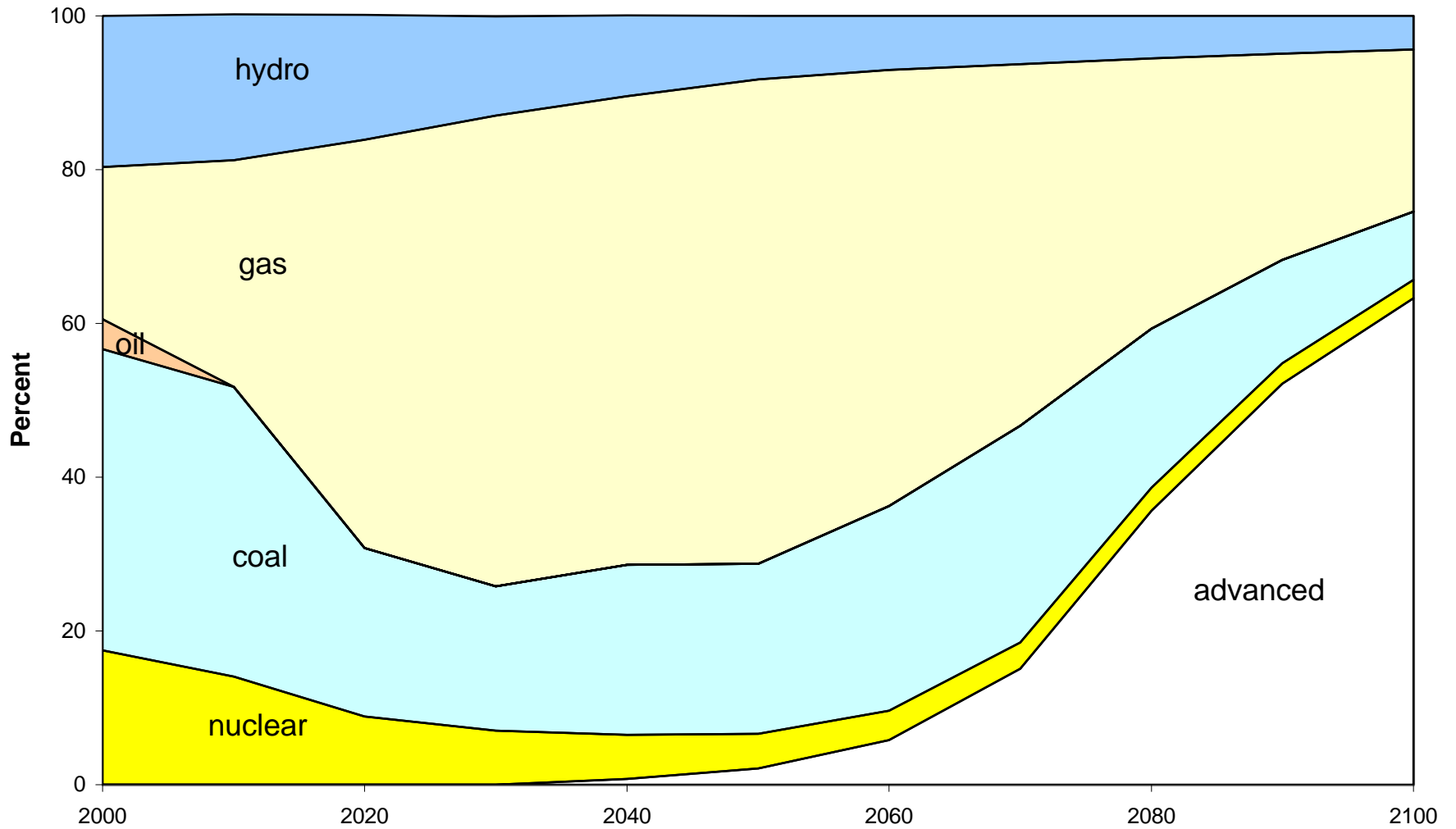
Electric Energy Technologies

(subject to introduction and decline constraints)

*hydro	hydroelectric and geothermal
*gas-r	gas-fired - remaining
gas-n	gas-fired - new
gas-a	gas-fired - advanced (not available until 2020)
*oil-r	oil-fired - remaining
*coal-r	coal-fired - remaining
coal-n	coal-fired - new
coal-a	coal-fired - advanced (not available until 2020)
*nuc-r	nuclear
“Advanced” includes: wind, photovoltaics, biomass, nuclear and fusion; also coal with capture and sequestration.	
adv-hc	advanced - carbon-free - high cost
adv-lc	advanced - carbon free - low cost (not available until 2040)

*Year-by-year supplies are limited

**Figure 1. Generation Mix - Reference Case:
Percent of World Electricity Generation**



Electricity Generating Technology Characteristics

	\$ per thousand KWH	date of availability
COAL-N	51	2000
ADV-HC	75	2010
ADV-LC	50	2040

Issues

- Distinguishing between technology invention and technology diffusion
- Endogenizing diffusion process in energy-economy models
- Determining whether it makes a difference in terms of greenhouse gas mitigation strategy

Decision Variables

$X_{r,t}$ = sum of ADV-HC and ADV-LC available
in region r, decade t

$E_{r,t}$ = total electricity generation in region r, decade t

Numerical Assumptions

- initial market share = 1%
- regional expansion factor, rxf = 2 per decade
- global diffusion factors,

$$\text{gdf}_{r,t} = E_{r,t} / \sum_{rg} E_{rg,t}$$

Expansion Limits

$$X_{r,t+1} \leq .01 E_{r,t+1}$$

(advanced technologies are limited to 1% of the total electricity market in their first year of deployment)

$$+ 2 X_{r,t}$$

(advanced technologies may expand by a factor of 2 over their prior decade value in region r)

$$+ \text{gdif}_{r,t} \sum_{rg} X_{rg,t}$$

(advanced technologies may expand by a global diffusion factor of gdif over their prior decade value in all regions, with the share of region r being determined by its share of global electricity generation)

**Figure 2. ADV Technologies - Percent of World Electricity Generation
(for alternative rates of global temperature increase)**

