Activities for Global Scenario Development by RITE

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Overview of Major Current Activities for Scenario Development

- Narrative scenario development

with Mr. Taishi Sugiyama, CRIEPI and several experts on technologies, forestry, agricultures, finance etc.

Short-term (-2030): bottom-up/forward-looking

Long-term (-2100/onward): top-down/back-casting

Tentative scenarios: Mar. 2009; Final scenarios: Mar. 2010

- Development of several types of models

Mitigation: DNE21+, DEARS (-2030/50); DNE21 (-2100/2200)

Impacts/adapt.: agriculture, water, human health, biodiversity etc.

- Development of consistent model for Land-use, agriculture, forestry, climate feedbacks, water resources, bioenergy etc.

- Development of quantitative scenarios having a consistency with narrative scenarios including contexts of sustainable development (*Final output: 2009-11*)

A Core Energy Systems Model: DNE21+

- Linear programming model (minimizing world energy system cost)
- Evaluation time period: 2000-2050

  Representative time points: 2000, 2005, 2010, 2015, 2020, 2025, 2030, 2040, 2050
- World divided into 54 regions (country level)

  Large area countries are further divided into 3-8 regions, and the world is divided into 77 regions.
- Bottom-up modeling for technologies both in energy supply and demand sides (Industry: iron&steel, cement, aluminum, paper&pulp, chemical, Transport: automobiles, Res.&com.: refrigerator, TV, air-conditioner etc.)
- Primary energy: coal, oil, natural gas, hydro&geothermal, wind, photovoltaics, biomass and nuclear power
- Interregional trade: coal, crude oil, natural gas, syn. oil, ethanol, hydrogen, electricity and CO_2
- Existing facility vintages are explicitly modeled.

- The model has high resolutions in regions and technologies.
- The model can evaluate the effects of sectoral/bottom-up policy and measures in each country.
- Consistent analyses among regions and sectors can be conducted.
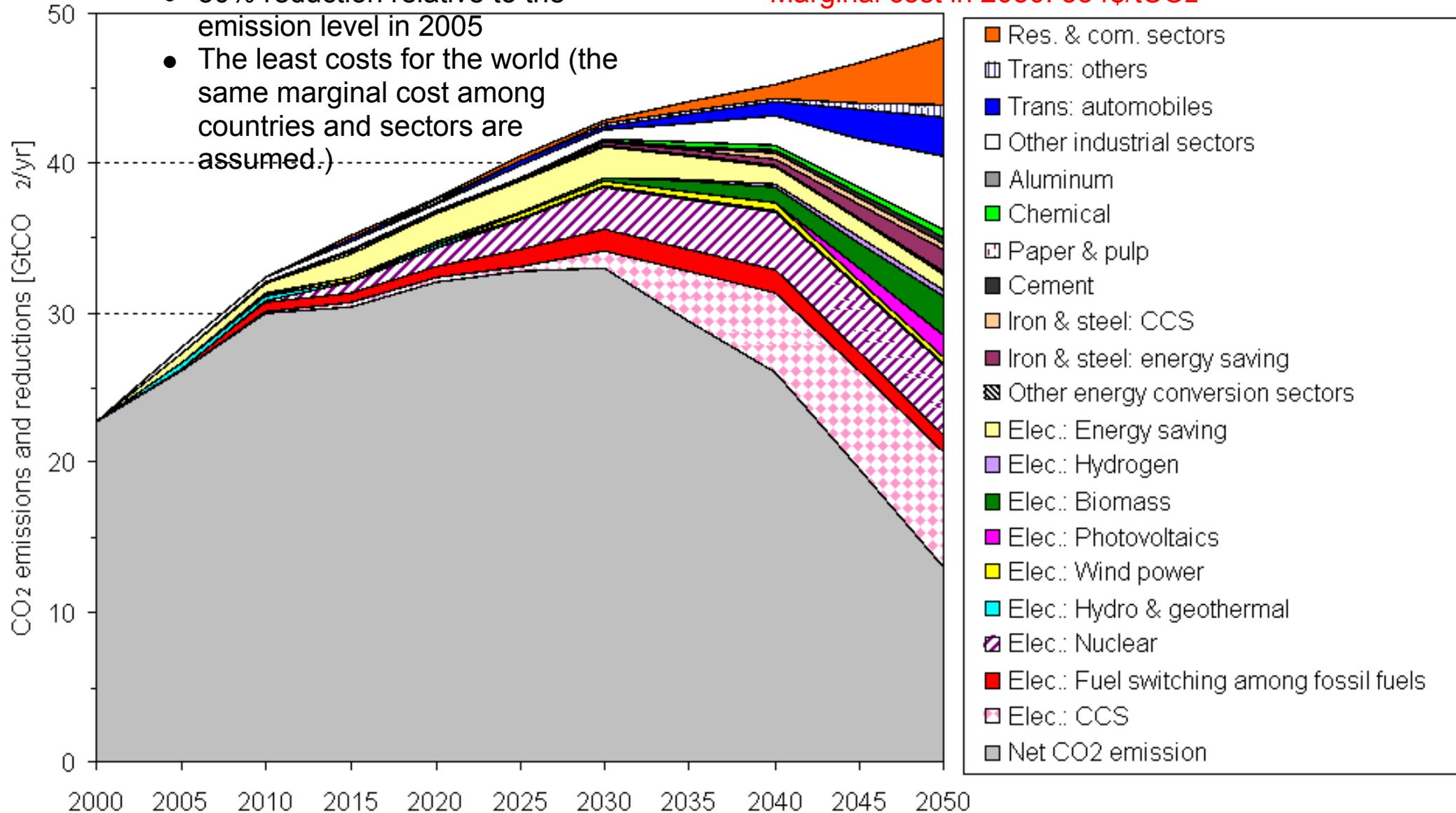
CO2 Emission Outlook
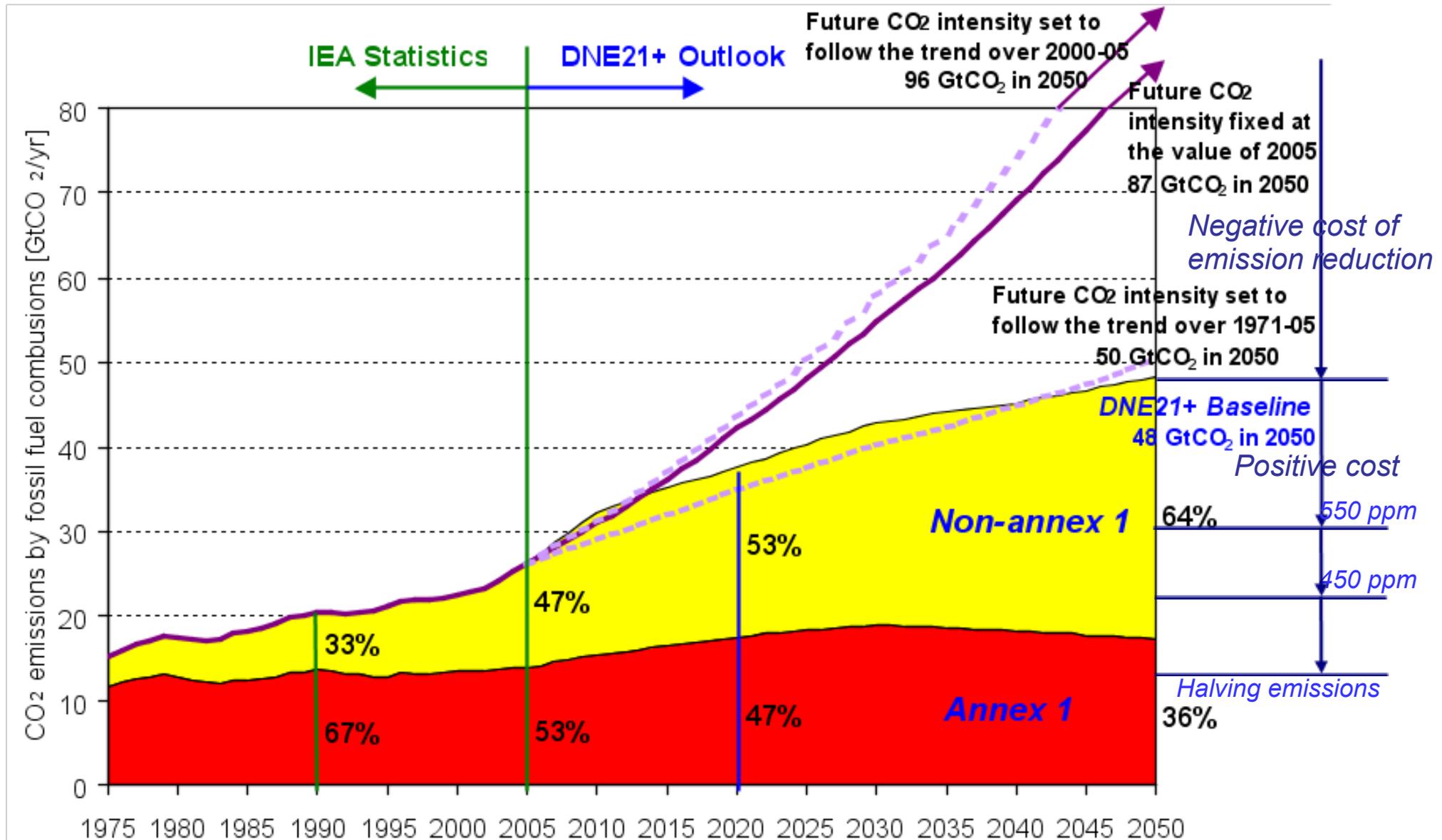
- Large opportunities of cost-effective measures (negative cost measures) exist in the world.
- Our activities focus on clarifying how to achieve them through bottom-up assessments.

An Example Assessment for Detailed Technological Measures with DNE21+

- 50% reduction relative to the emission level in 2005
- The least costs for the world (the same marginal cost among countries and sectors are assumed.)

Marginal cost in 2050: 334$/tCO2

Legend:
- Res. & com. sectors
- Trans: others
- Trans: automobiles
- Other industrial sectors
- Aluminum
- Chemical
- Paper & pulp
- Cement
- Iron & steel: CCS
- Iron & steel: energy saving
- Other energy conversion sectors
- Elec.: Energy saving
- Elec.: Hydrogen
- Elec.: Biomass
- Elec.: Photovoltaics
- Elec.: Wind power
- Elec.: Hydro & geothermal
- Elec.: Nuclear
- Elec.: Fuel switching among fossil fuels
- Elec.: CCS
- Net CO2 emission

Y-axis: CO_2 emissions and reductions [GtCO$_2$/yr]

- A highly bottom-up model can show the technological measures for each sector.
- Technologically feasible, but …

Land Use Modeling Activity
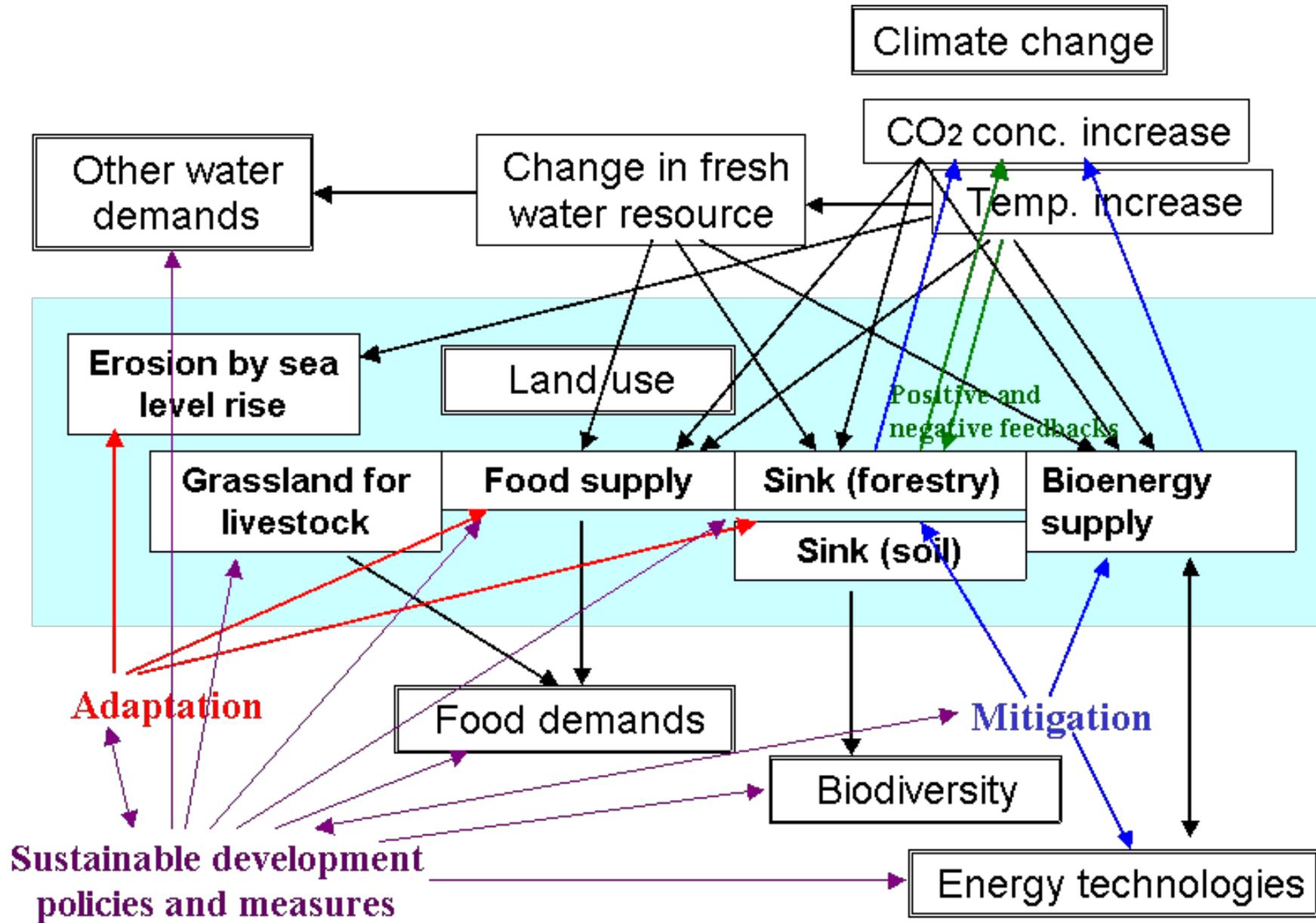
A land-use and land cover model having consistency with global warming mitigation models including DNE21+ and impact and adaptation models are under construction.

Technology Descriptions in DNE21+

Fossil fuels
Coal
Oil (conventional, unconv.)
Gas (conventional, unconv.)

Unit production cost

Cumulative production

Renewable energies
Hydro power & geothermal
Wind power
Photovoltaics
Biomass

Unit supply cost

Annual production

Nuclear power

Energy conv. processes

(oil refinery, coal gasification, bio-ethanol, gas reforming, water electrolysis etc.)

Electric Power generation

CCS

Industry

Iron & steel

Cement

Paper & pulp

Chemical (ethylene, propylene, ammonia)

Aluminum

Solid, liquid and gaseous fuels, and electricity

Transport

vehicle

Solid, liquid and gaseous fuels, and electricity

Residential & commercial

Refrigerator, TV, air conditioner etc.

Solid, liquid and gaseous fuels, and electricity