

Carbon Sinks and Land Use Competition

EU-FASOM

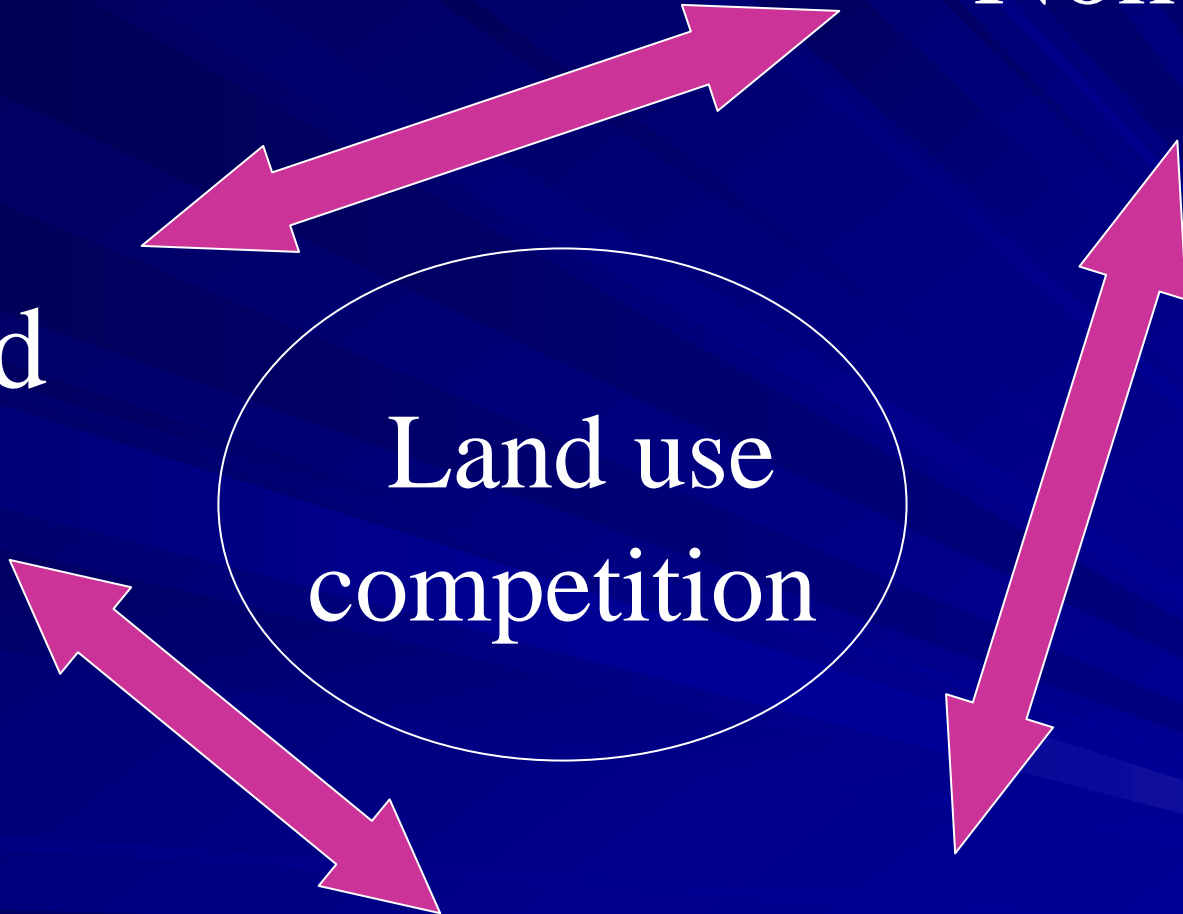
Uwe A. Schneider
Dagmar Schwab
INSEA Colleagues

Non-Food

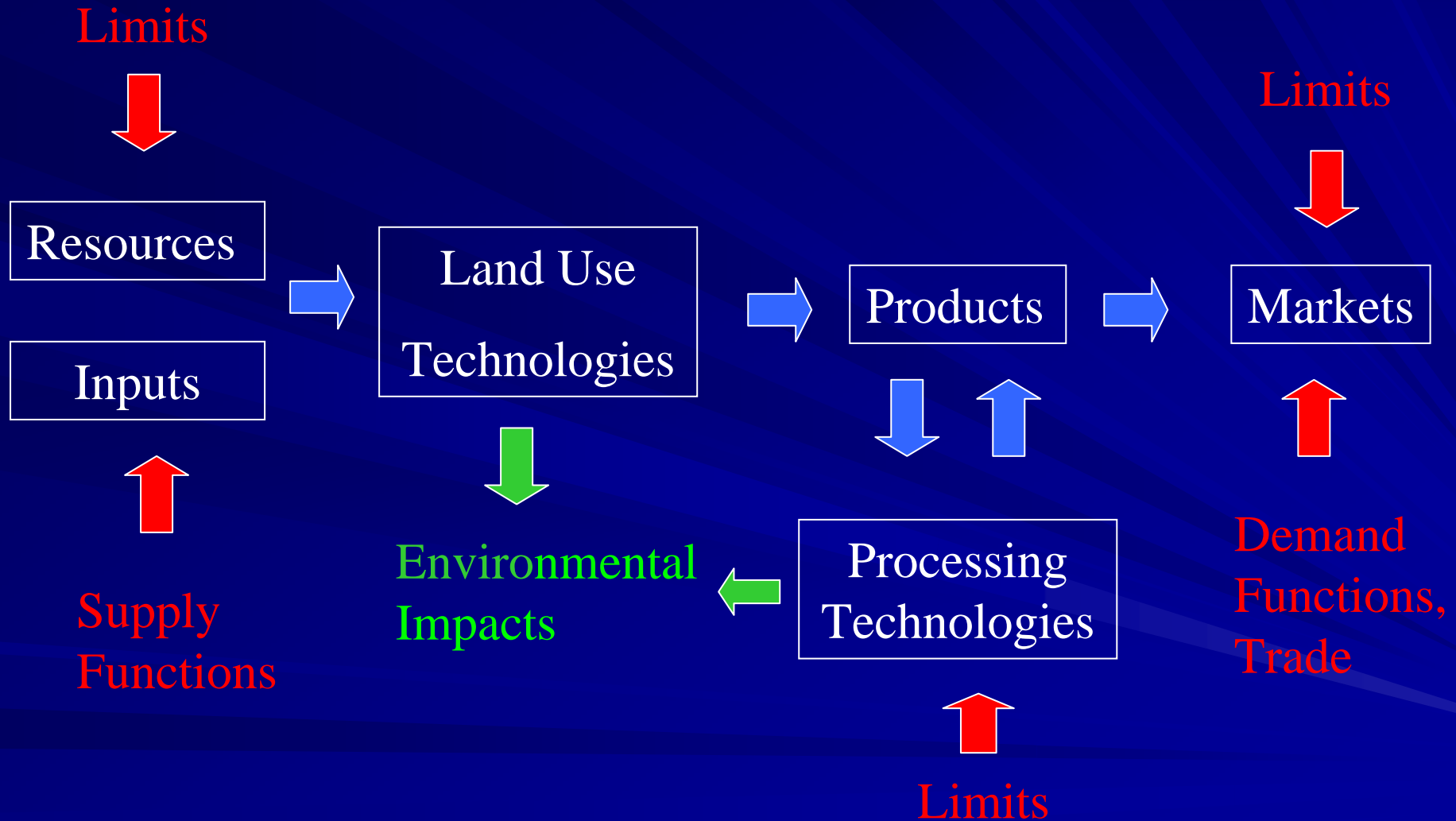
Food

Land use
competition

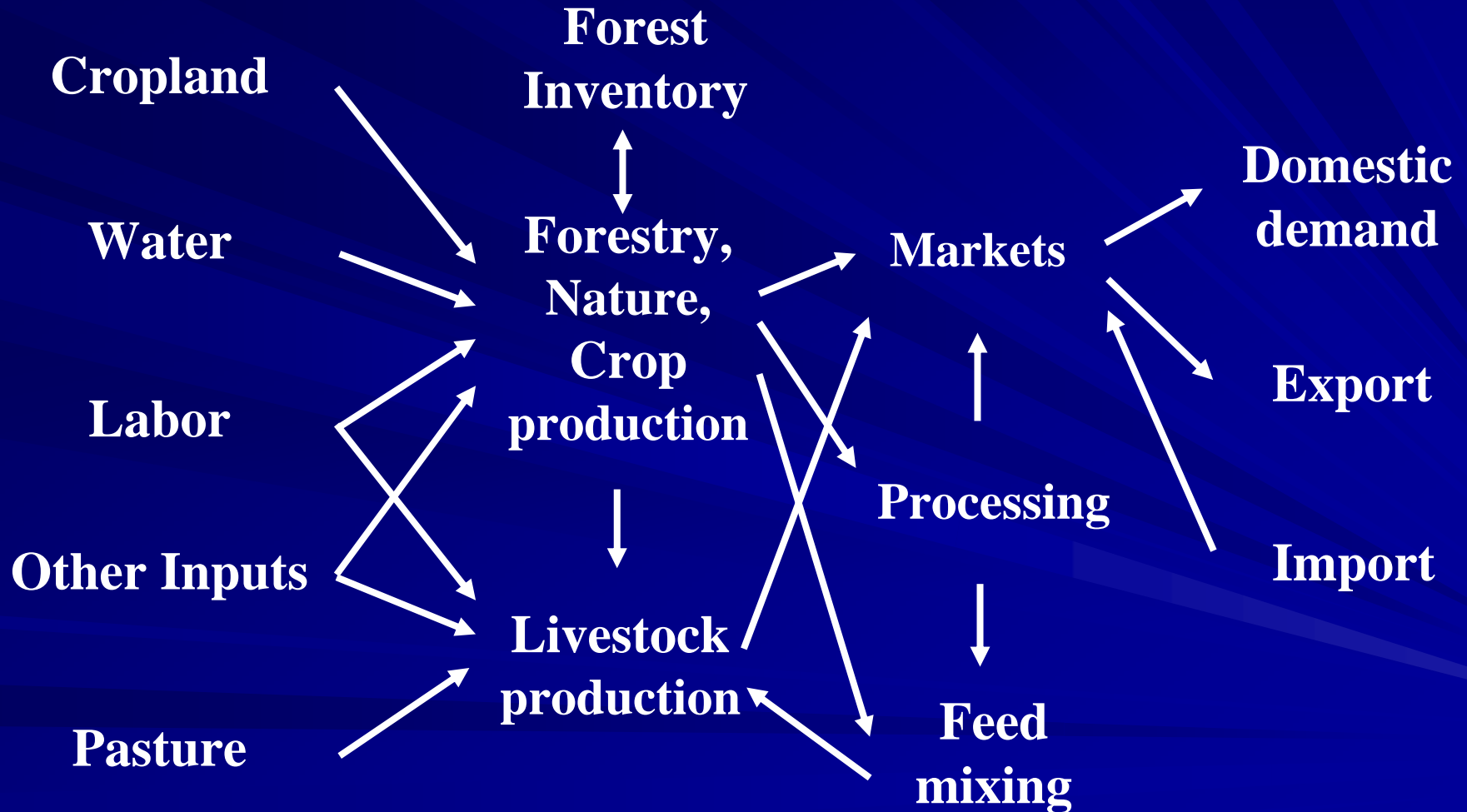
Carbon Sinks



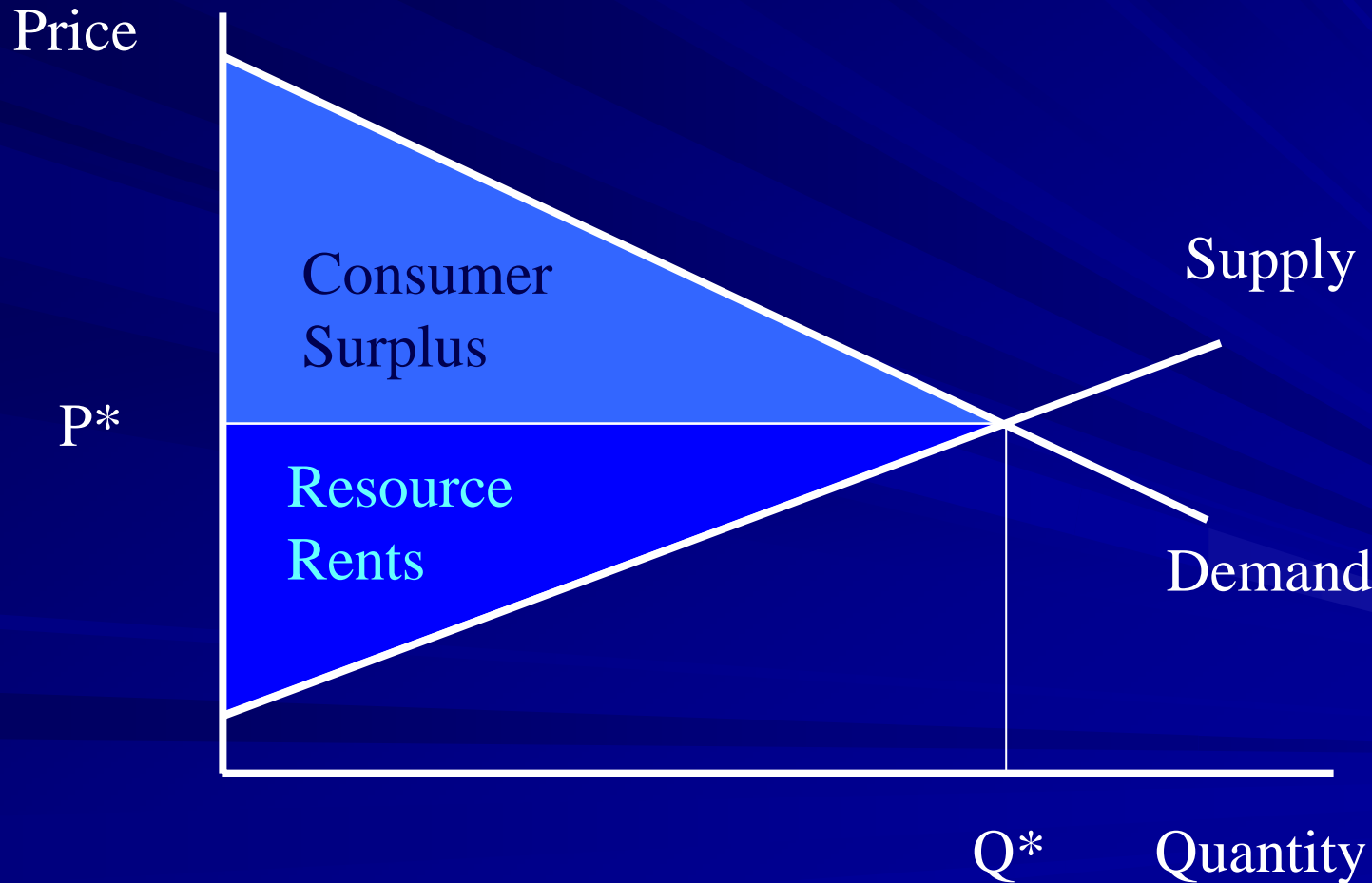
Model Structure



Model Structure



Objective Function



Surplus Maximization



Land Supply



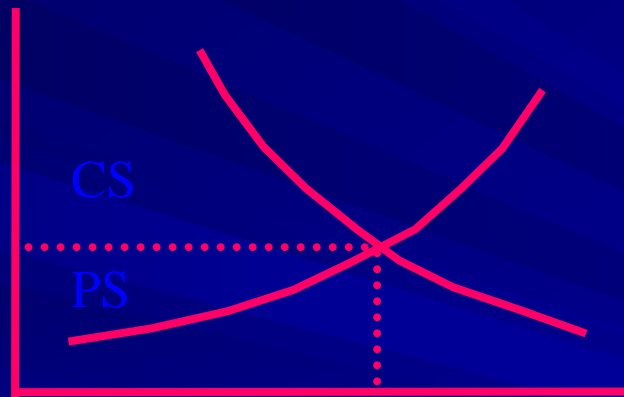
Forest Inventory



Processing Demand



Water Supply



Implicit Supply and Demand



Domestic Demand



Labor Supply



Feed Demand



Animal Supply



National Inputs



Import Supply



Export Demand

Spatial Resolution

- Soil texture
- Stone content
- Altitude levels
- Slopes
- Soil state
- Political regions
- Ownership (forests)
- Farm types
- Farm size
- Many crop and tree species
- Tillage, planting irrigation, fertilization harvest regime

EUFASOM Dynamics

- 5 (to 20) year time steps
- State of forests (and soil organic matter)
- Technical progress
- Demand & industry growth
- Resource and global change
- Policy scenarios

State of the Art

- Enormous flexibility (resolve acc. needs)
- Index notation
 - millions of data, variables, and equations with sparse programming statements
 - ensures consistency (model development)
- Extensive generic equation checks (30 checks per equation)
- Systematic solution analysis (symptom to cause)

Positive Variables

RESOURCE_VAR (PERIOD,REGION,RESOURCE)

FOREST_VAR (PERIOD,REGION,SOILTYPE,SOILSTATE,SPECIES,OWNER,AGE,FORTECH)

PEREN_VAR (PERIOD,REGION,SOILTYPE,SOILSTATE,SPECIES,FARM,AGE,CROPTECH)

CROP_VAR (PERIOD,REGION,SOILTYPE,SOILSTATE,SPECIES,FARM,CROPTECH)

LIVE_VAR (PERIOD,REGION,ANIMAL,LIVETECH)

FEED_VAR (PERIOD,REGION,ANIMAL,PRODUCT,FEEDTECH)

ECO_VAR (PERIOD,REGION,SOILTYPE,SOILSTATE,ECOTECH)

PROCESS_VAR (PERIOD,REGION,PROCTECH)

LUC_VAR (PERIOD,REGION,SOILTYPE,SPECIES,CHANGE)

DEMAND_VAR (PERIOD,REGION,PRODUCT)

SUPPLY_VAR (PERIOD,REGION,PRODUCT)

TRADE_VAR (PERIOD,REGION,REGION,PRODUCT)

Equations

OBJECTIVE_EQU

RESOURCEBAL_EQU (PERIOD,REGION,RESOURCE)

RESOURCEMAX_EQU (PERIOD,REGION,RESOURCE)

SOILSTATE_EQU (PERIOD,REGION,SOILTYPE,SOILSTATE)

FORINVENT_EQU (PERIOD,REGION,SOILTYPE,SOILSTATE,SPECIES,OWNER,AGE,FORTECH)

LUC_EQU (PERIOD,REGION,SOILTYPE,SPECIES,CHANGE)

LUCLIMIT_EQU (PERIOD,REGION,SOILTYPE,SPECIES,CHANGE)

STOCK_EQU (PERIOD,REGION,STOCK)

EMIT_EQU (PERIOD,REGION,SUBSTANCE)

PRODUCTBAL_EQU (PERIOD,REGION,PRODUCT)

MINFEED_EQU (PERIOD,REGION,ANIMAL,NUTRIENT)

MAXFEED_EQU (PERIOD,REGION,ANIMAL,NUTRIENT)

Data

FOREST_DATA (PERIOD,REGION,SOILTYPE,SOILSTATE,SPECIES,FARM,AGE,ALLTECH,ALLITEM)

PEREN_DATA (PERIOD,REGION,SOILTYPE,SOILSTATE,SPECIES,FARM,AGE,ALLTECH,ALLITEM)

CROP_DATA (PERIOD,REGION,SOILTYPE,SOILSTATE,SPECIES,FARM,ALLTECH,ALLITEM)

ECO_DATA (PERIOD,REGION,SOILTYPE,SOILSTATE,ALLTECH,ALLITEM)

LIVE_DATA (PERIOD,REGION,ANIMAL,ALLTECH,ALLITEM)

FEED_DATA (PERIOD,REGION,PRODUCT,ALLTECH,ALLITEM)

PROCESS_DATA (PERIOD,REGION,ALLTECH,ALLITEM)

PRODUCT_DATA (PERIOD,REGION,PRODUCT,ALLITEM)

MARKET_DATA (PERIOD,REGION,ALLITEM,SDTYPE,SDITEM)

TRADE_DATA (PERIOD,REGION,REGION,PRODUCT,ALLITEM)

RESOURCE_DATA (PERIOD,REGION,ALLRESOURCE,SDITEM)

STOCK_DATA (PERIOD,REGION,PRODUCT,ALLITEM)

LUC_DATA (PERIOD,REGION,SOILTYPE,SPECIES,ALLCHANGE,ALLITEM)

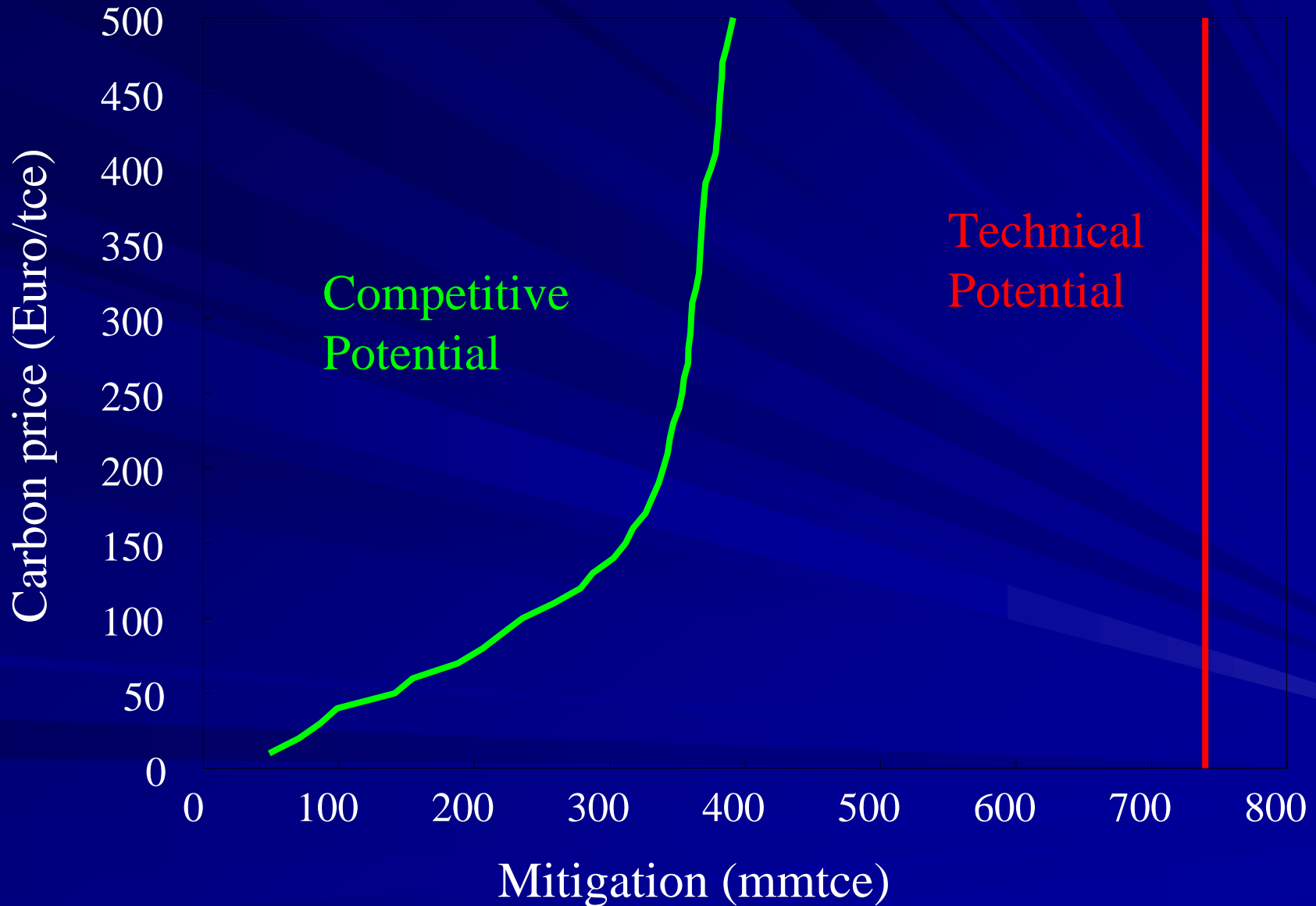
Pre-Solution Analysis

- Identifies structural errors
 - Missing data
 - Illegal data
 - Wrong signs
- More than 30 general variable and equation checks

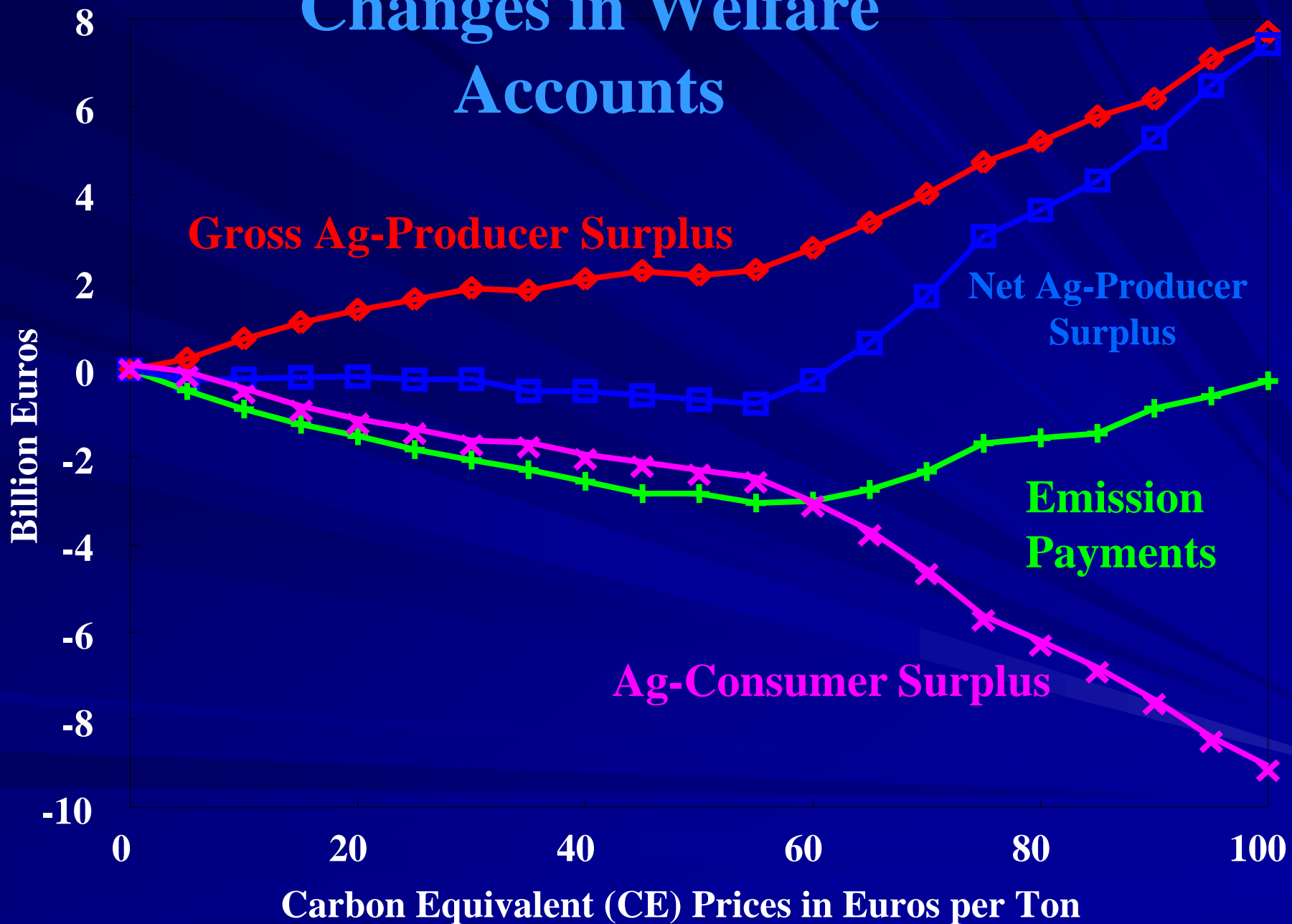
Crop Technology Data Base

Region	Altitud	Soil	Farm	Rotation	Water	Tillage	Fertilz	Residue	Item	Unit	Value
Poland	0-300	Sand	ES3	W-W-S	Irrig	Conv.	Basic	Basic	Wheat	dt/ha/y	50
Poland	0-300	Sand	ES3	W-W-S	Irrig	Conv.	Basic	Basic	S-Beat	dt/ha/y	200
Poland	0-300	Sand	ES3	W-W-S	Irrig	Conv.	Basic	Basic	Straw	dt/ha/y	50
Poland	0-300	Sand	ES3	W-W-S	Irrig	Conv.	Basic	Basic	Labor	hr/ha/y	30
Poland	0-300	Sand	ES3	W-W-S	Irrig	Conv.	Basic	Basic	Land	ha/ha/y	1
Poland	0-300	Sand	ES3	W-W-S	Irrig	Conv.	Basic	Basic	Diesel	l/ha/y	40
Poland	0-300	Sand	ES3	W-W-S	Irrig	Conv.	Basic	Basic	Costs	Eur/ha/y	300
Poland	0-300	Sand	ES3	W-W-S	Irrig	Conv.	Basic	Basic	Soil-C	kg/ha/y	50
Poland	0-300	Sand	ES3	W-W-S	Irrig	Conv.	Basic	Basic	Erosion	kg/ha/y	15
Poland	0-300	Sand	ES3	W-W-S	Irrig	Conv.	Basic	Basic	NO3-L	kg/ha/y	20

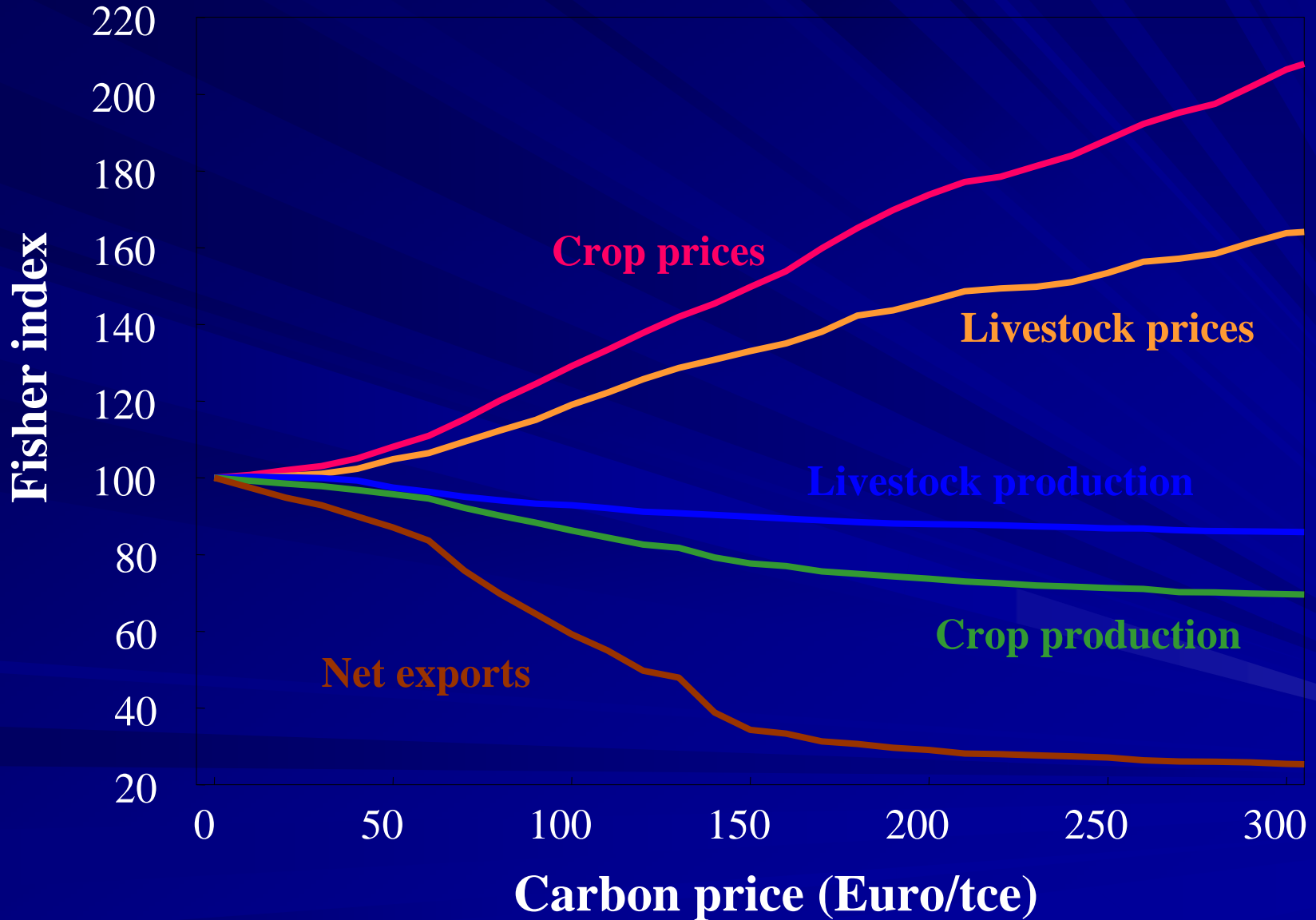
Mitigation Potentials



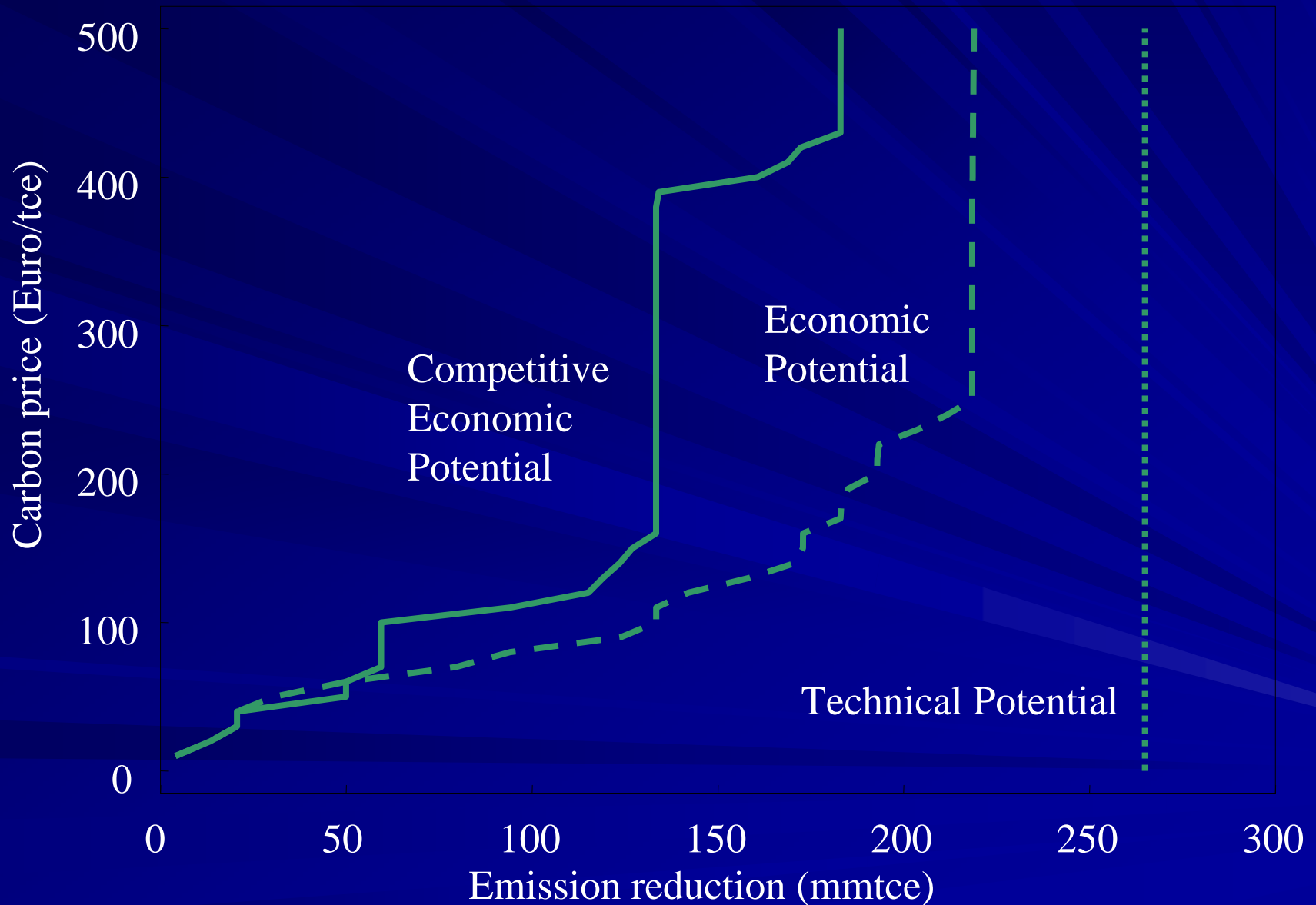
Changes in Welfare Accounts



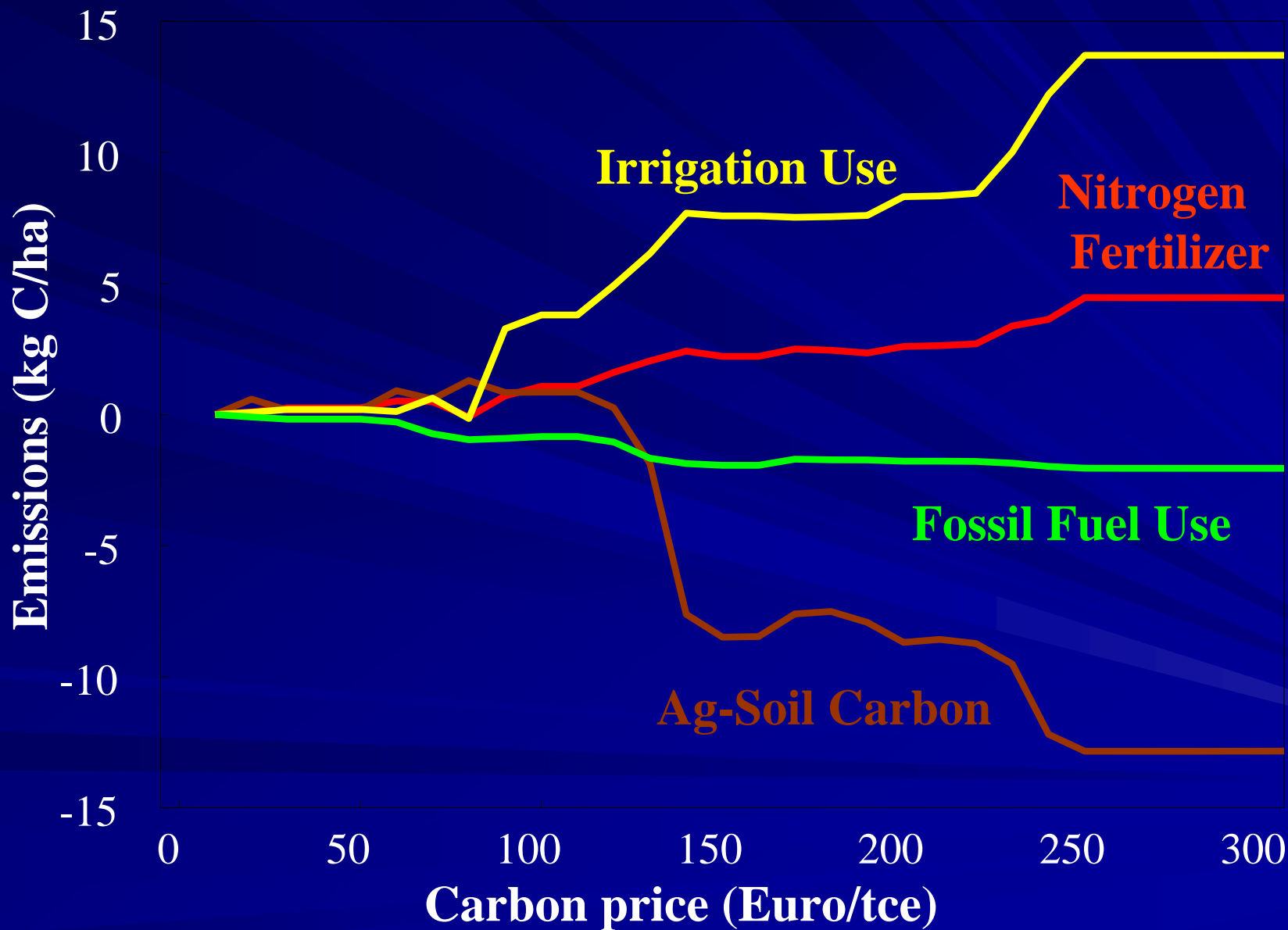
GHG Mitigation and Markets

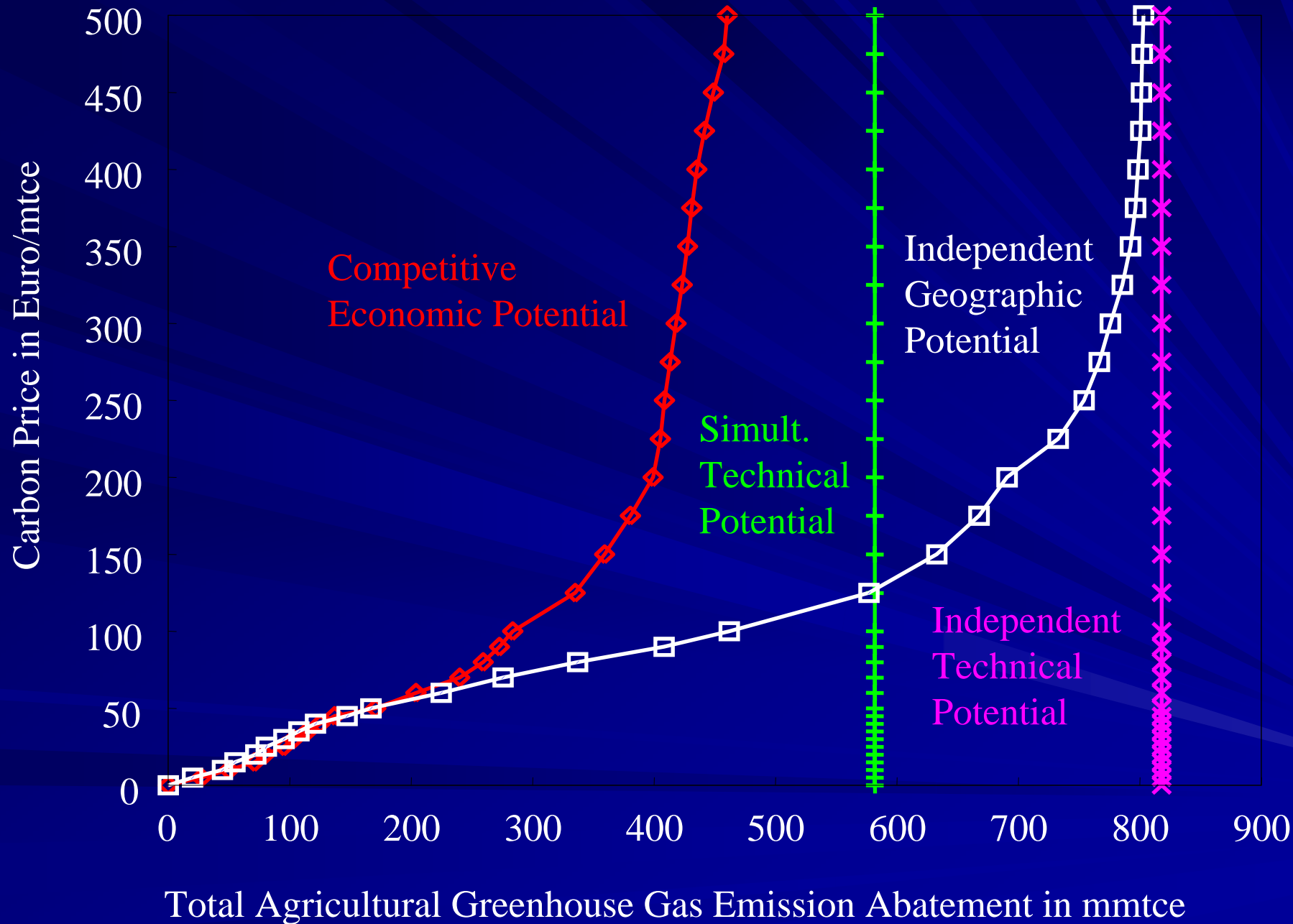


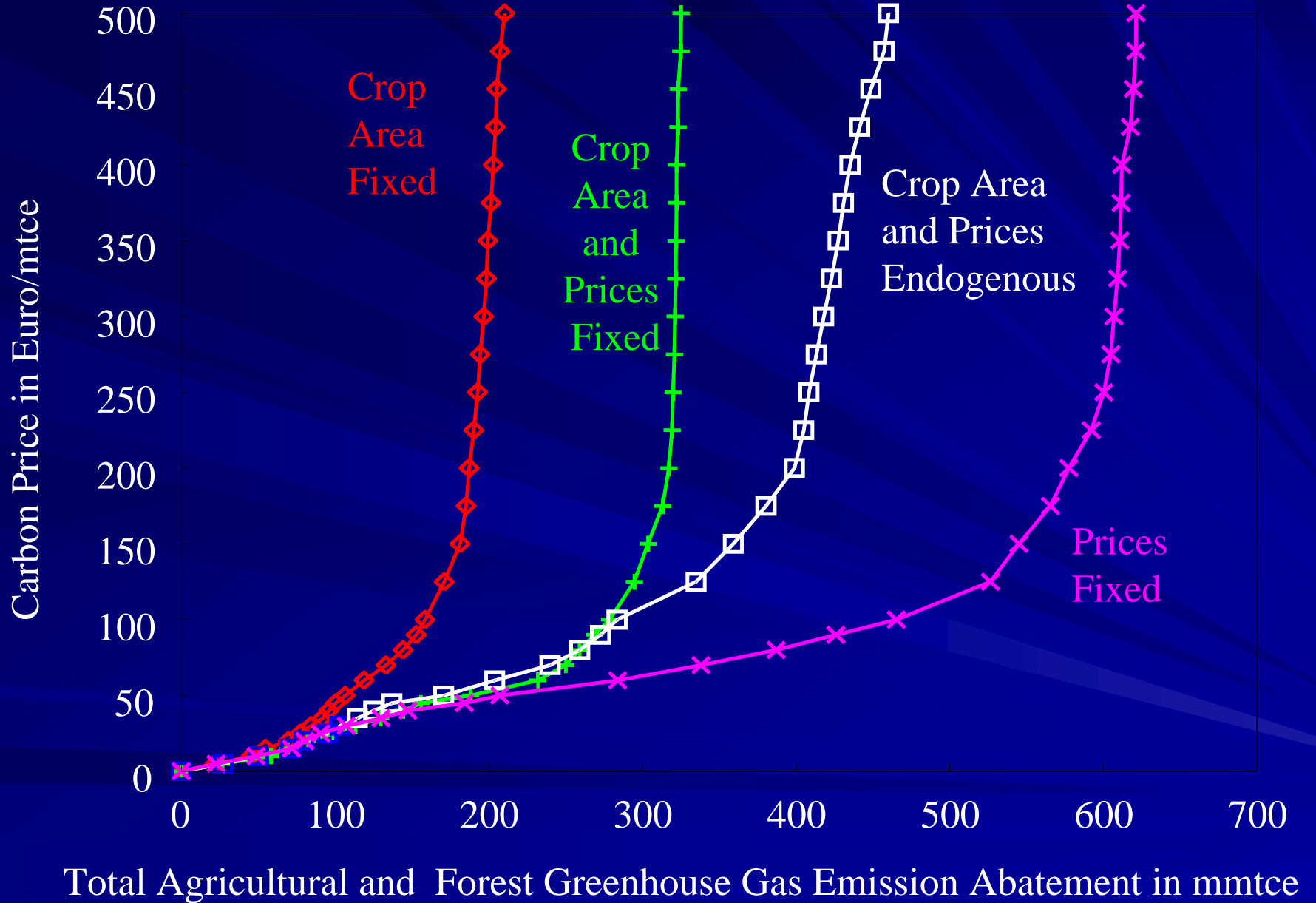
Afforestation Potentials



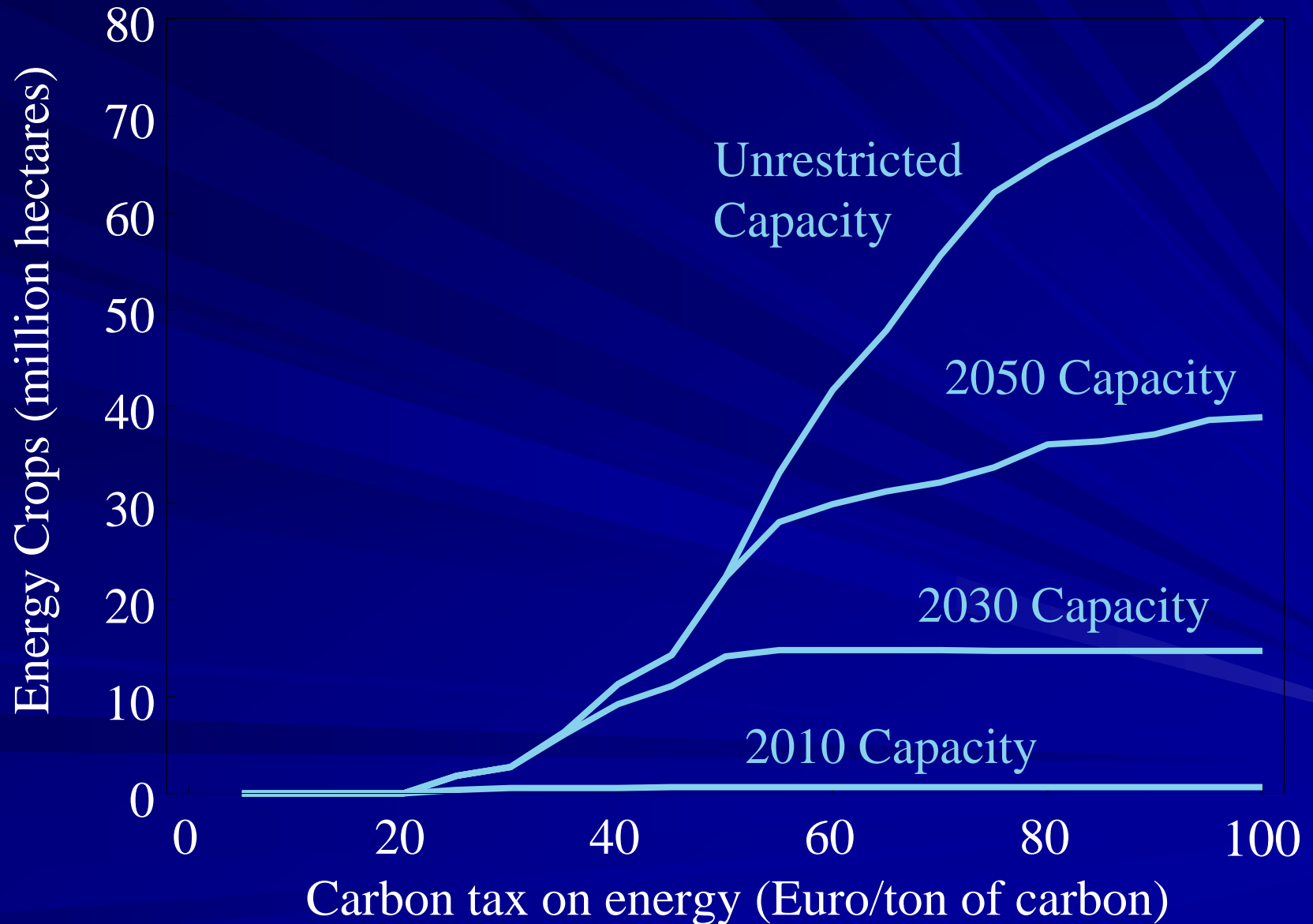
Forest Policy: Crop Emissions



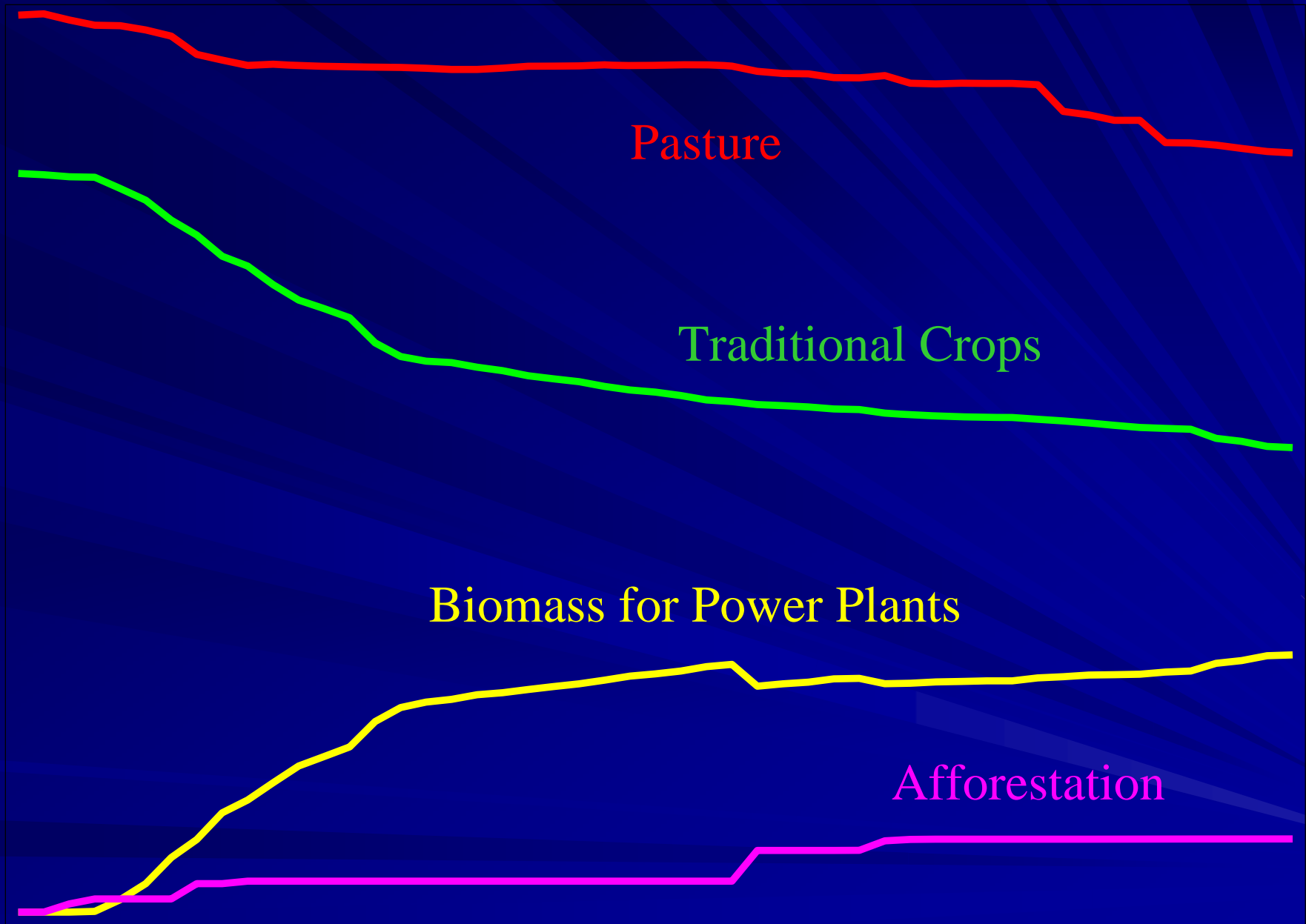




Power Plant Biomass Supply



Land Allocation



Pasture

Traditional Crops

Biomass for Power Plants

Afforestation

Carbon Tax

Outlook

- Analysis of major FASOM results
- Downscaling (EFEM, AROPAJ)
- Upscaling (GAINS, MESSAGE)

Thanks