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Econometric Model to predict the effect that various Water Resource Management Scenarios would have on South Africa's Economic Development

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CONTENT OF RSA PRESENTATION

- Overview of progress with the South African Inter-Industry Model (SAFRIM)
- The linkages to the Water Satellite Model (WSM)
- SAFRIM: Technical Presentation
- Demonstration

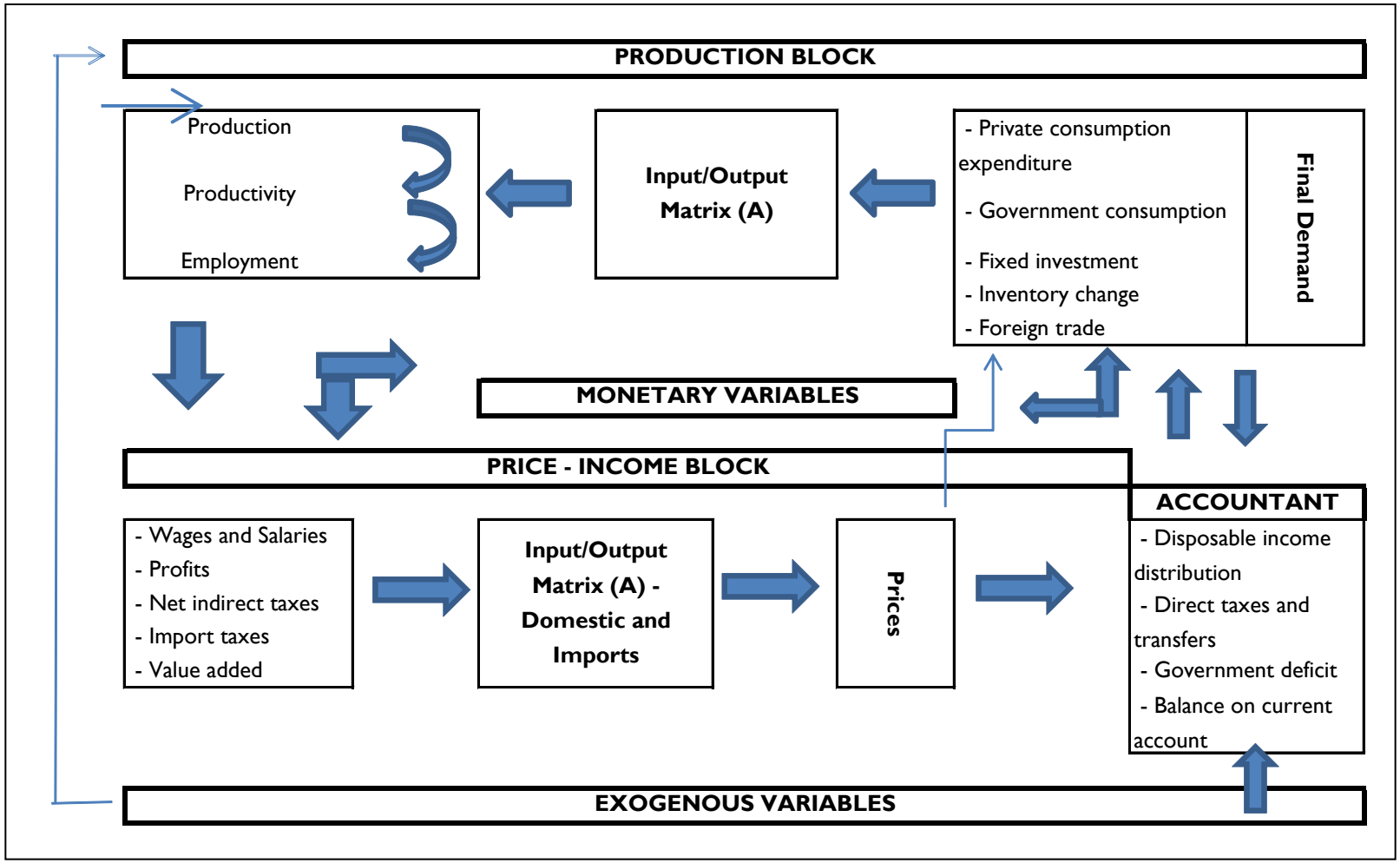
OBJECTIVE

- Development of an integrated macro-econometric model.
- Development of an appropriate analytical framework to examine effect of water policies.

RESEARCH PLAN

- Overall planning of research benchmark and theoretical conceptualization.
- Construction of model and collating of data.
- Technical validation of the model and scenario building.
- Final Report.

BASIC STRUCTURE OF SAFRIM

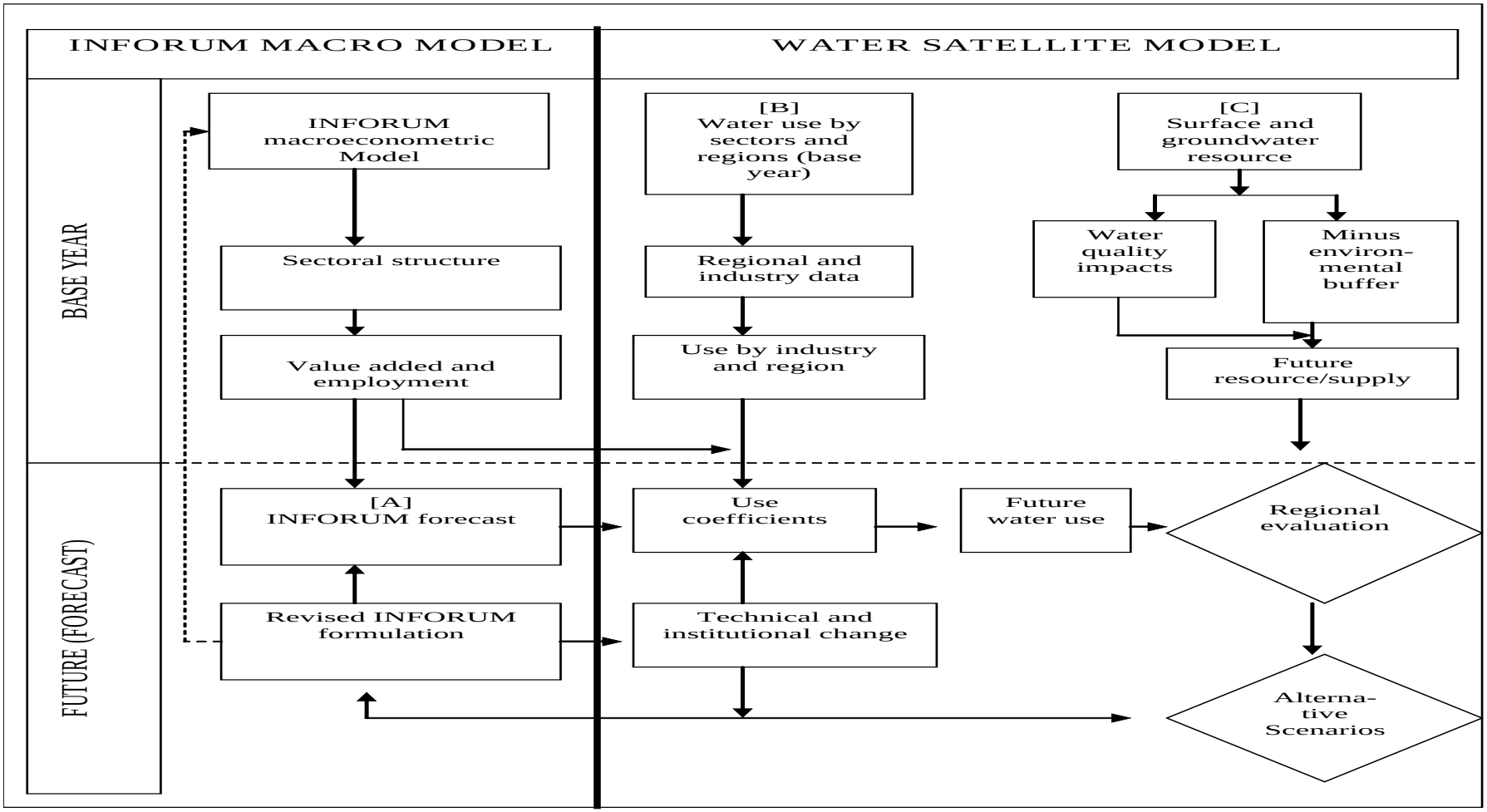


INTEGRATED WATER MODEL

- Integrating water sector into overall modeling.
  - See diagram 2
- Compiling Water Satellite Model
  - National Water Satellite Model.
  - Regional Water Satellite Model.
- Data requirements for Water Satellite Model.

INTEGRATED WATER MODEL

Diagram 1: Model Structure



COMPONENTS OF INTEGRATED MODEL

- Demonstrating analytical capabilities of integrated model.
- Water Satellite Model
  - Water Coefficients
  - Elasticities
  - Tariff Changes
  - Drivers
- Conducting a benchmark for sectoral water demand for national and regional areas.
- Water Multipliers
  - Employment
  - Gross Domestic Product
  - Investment
  - Household Income
- Scenario setting
  - National and Regional

THE FROMAL STRUCTURE OF THE WATER DEMAND FUNCTIONS

Incorporating both average demand coefficients (water coefficients) and the price elasticities of the demand for water per sector/user, the following mathematical equation will be used for modelling purposes:

where

$$D = [a + b(\Delta T)]C$$

D	**=**	**Total use for a category**
a	**=**	**Average use per user unit**
b	**=**	**Change in unit use due to a given tariff change**
ΔT	**=**	**Change in water tariff**
C	**=**	**Total number of user units (driver/exogenous variable)**

This kind of equation is widely used internationally mainly because of its theoretically sound foundations and the fact that it has found widespread practical applications . In the next chapter an analysis is given of the theoretical origin of the main elements of the above water demand function/equation, but in particular that of the price elasticity of demand.

THE FORMAL STRUCTURE OF THE WATER DEMAND FUNCTIONS

- Sectoral Distributions (Main Sectors)
  - Irrigation Agriculture
  - Mining
  - Manufacturing
  - Construction
  - Wholesale and Retail etc.
  - Transport
  - Communication
  - Financial Services
  - Other
  - Households
  - Total

THE FROMAL STRUCTURE OF THE WATER DEMAND FUNCTIONS

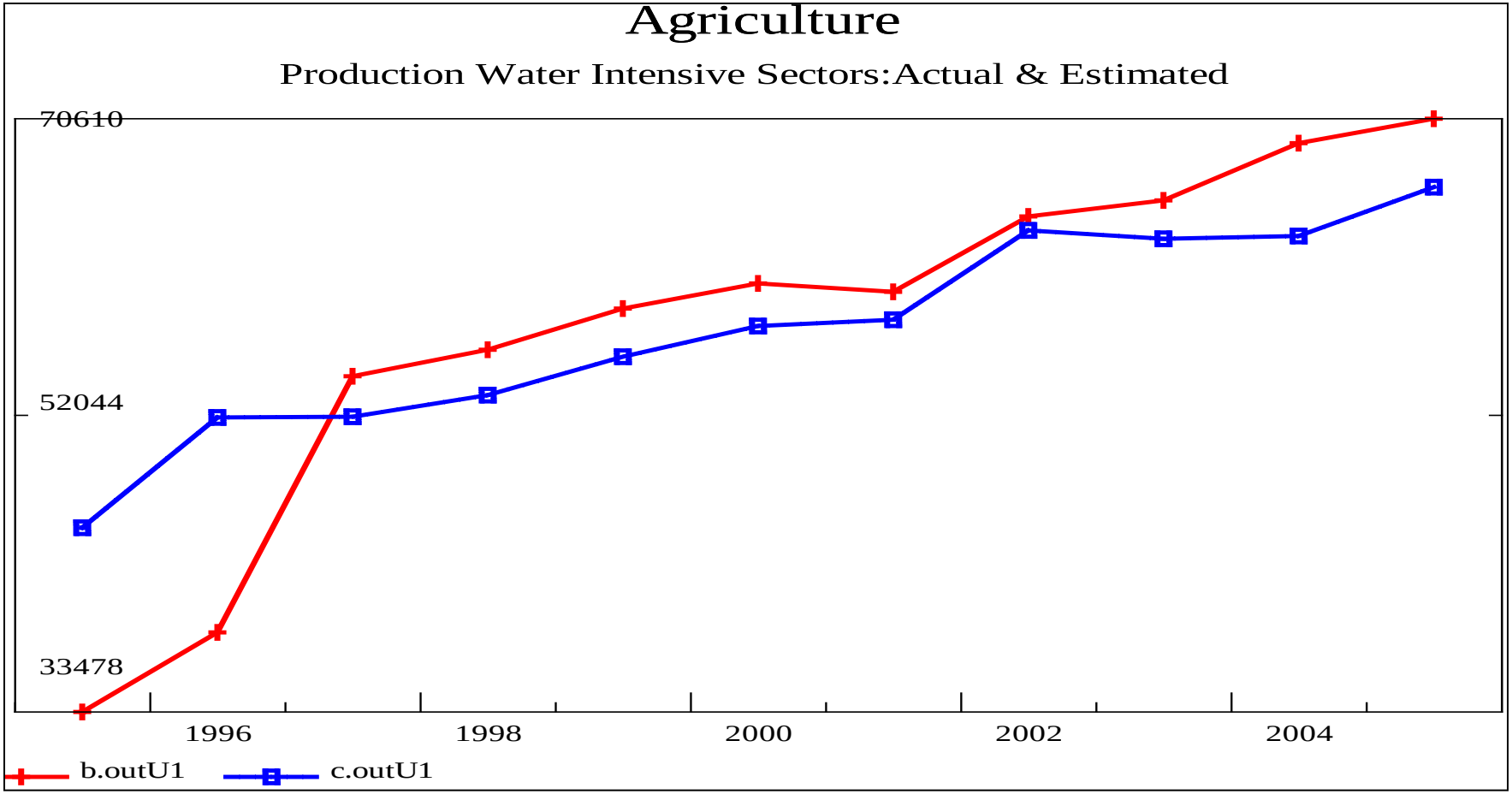
- Price elasticities of demand for water
- Water coefficients
  - Average water use (million cubic meter) per demand unit per annum.

	A Water Coefficients (million m^3)	B Elasticities	AT Tariff Charges (p.a.)	ΔC Number of users
Irrigation	0.007	-0.01152	0.2%	Hectares
Agriculture	-	-	-	Hectares
Forestry	0.00032	0.00	0.2%	Hectares
Livestock	45	0.00	0.2%	Stock Population(LSU)
Households - High	101.8	-0.35	0.9%	Population
Households - Medium	20.3	-1.12	0.9%	Population
Households - Low	20.3	-0.12	0.9%	Population
Mining	0.00202	-0.01589	0.9%	Production
Manufacturing	0.000724	-0.01589	0.9%	Production
Electricity and Water Supply	0.0014	-0.00022	0.9%	Production
Tertiary Sector	0.007247	-0.01436	0.9%	Production
Parks	74.64	-0.91	0.9%	Population

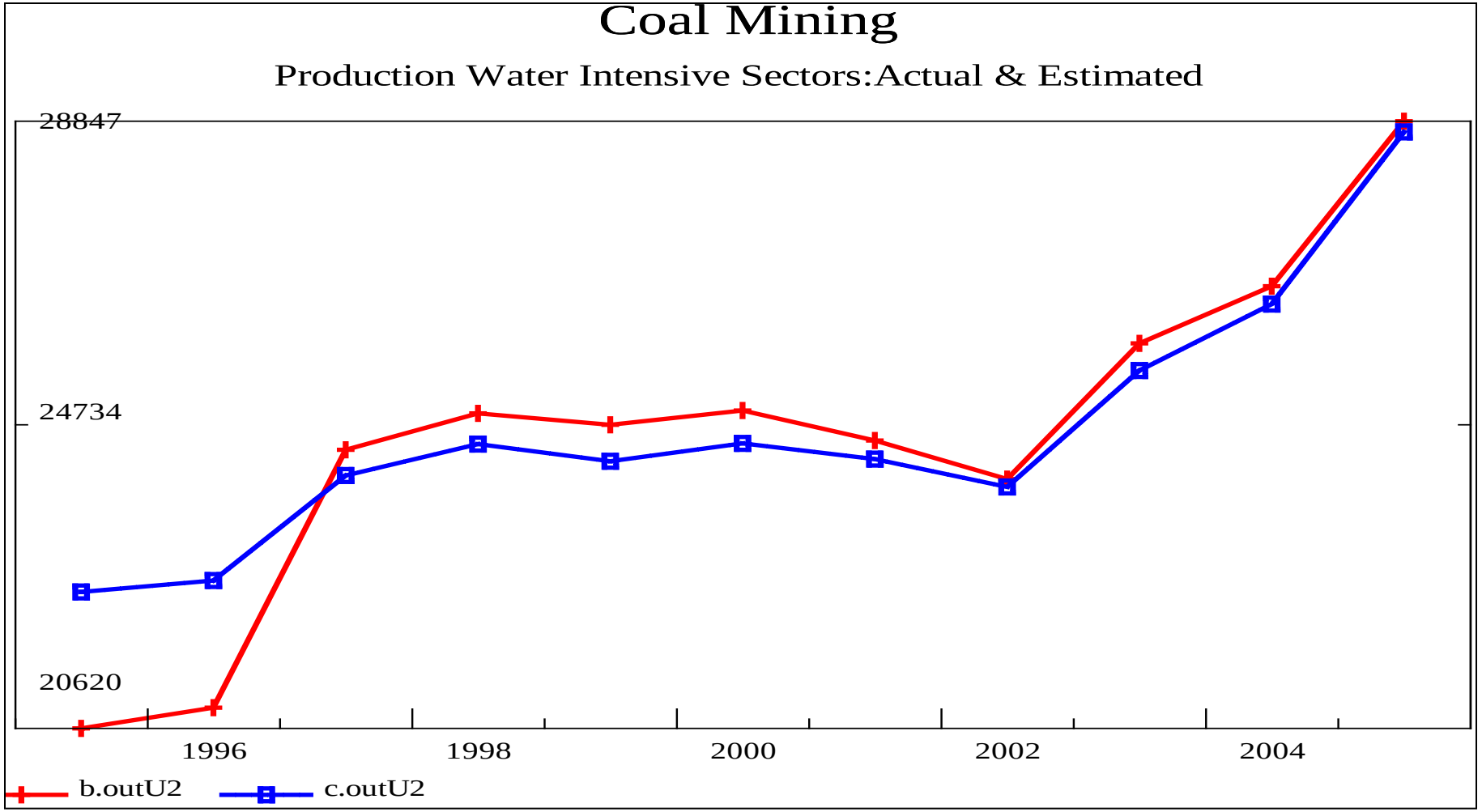
SCENARIO SETTING

- Base Scenario
  - 3% per annum growth
- High Growth
  - 6% per annum medium to long term
- High Tariff
- Location Constraint

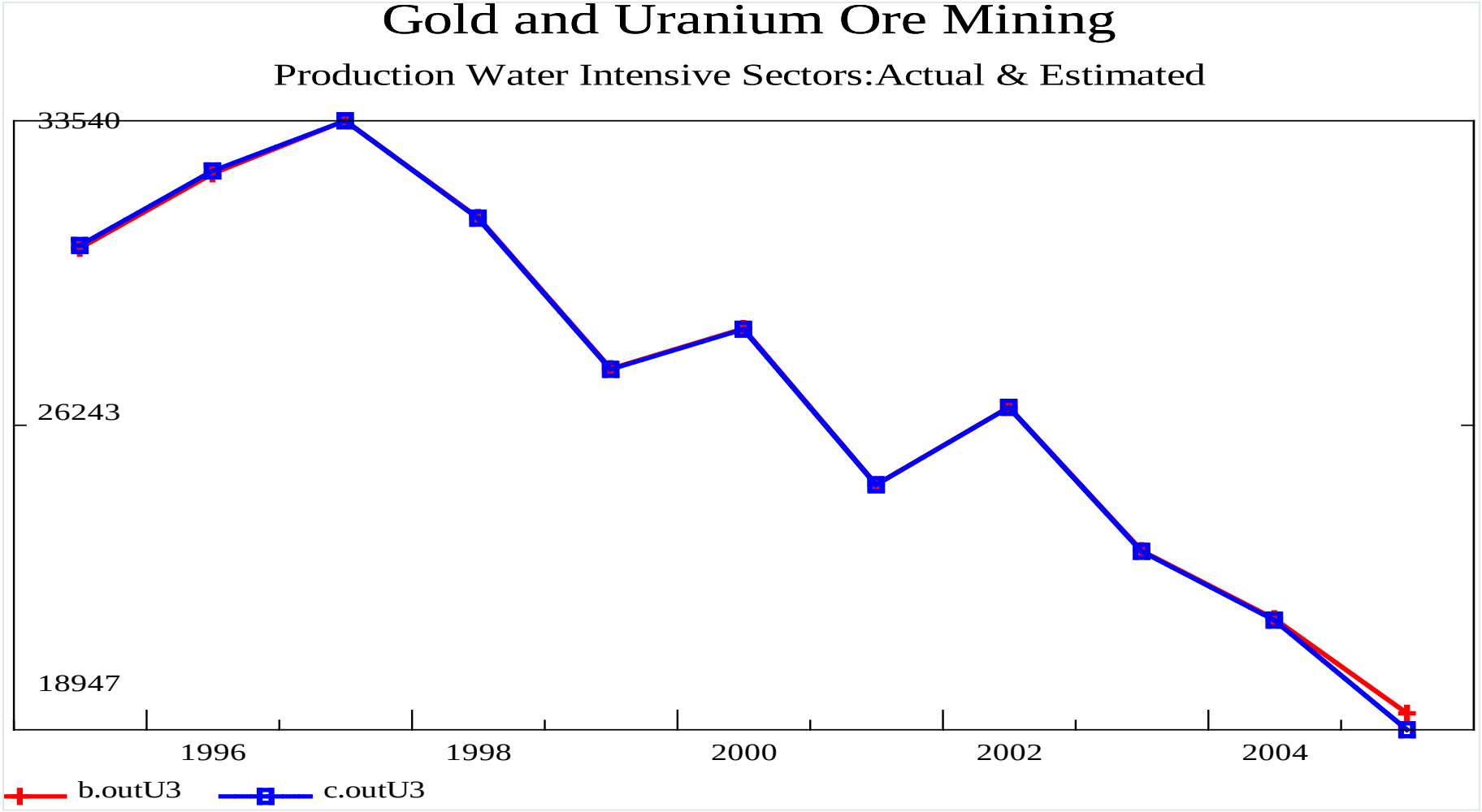
ACTUAL AND ESTIMATED SECTORAL PRODUCTION FOR SOME WATER INTENSIVE SECTORS (AGRICULTURE)



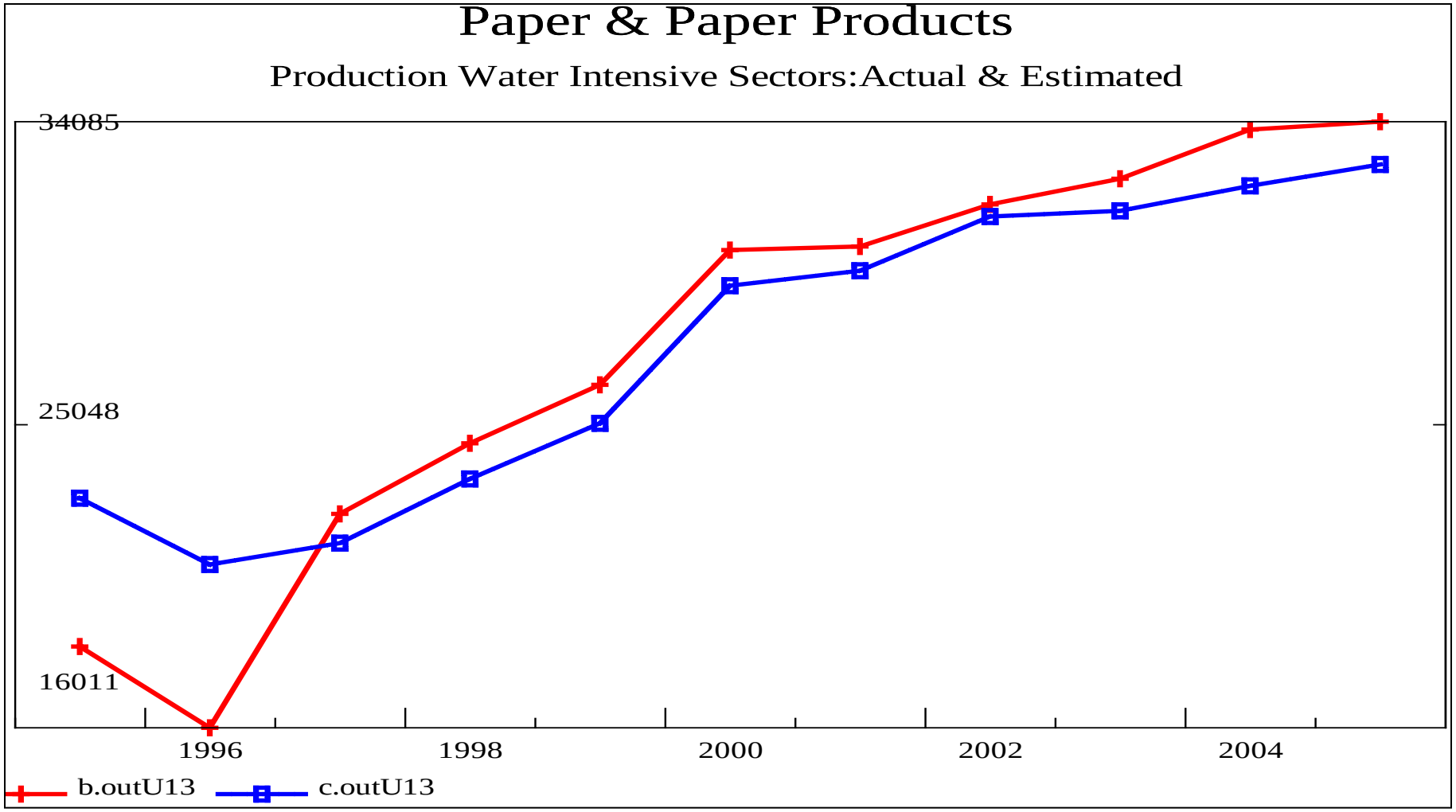
ACTUAL AND ESTIMATED SECTORAL PRODUCITON FOR SOME WATER INTENSIVE SECTORS (COAL MINING)



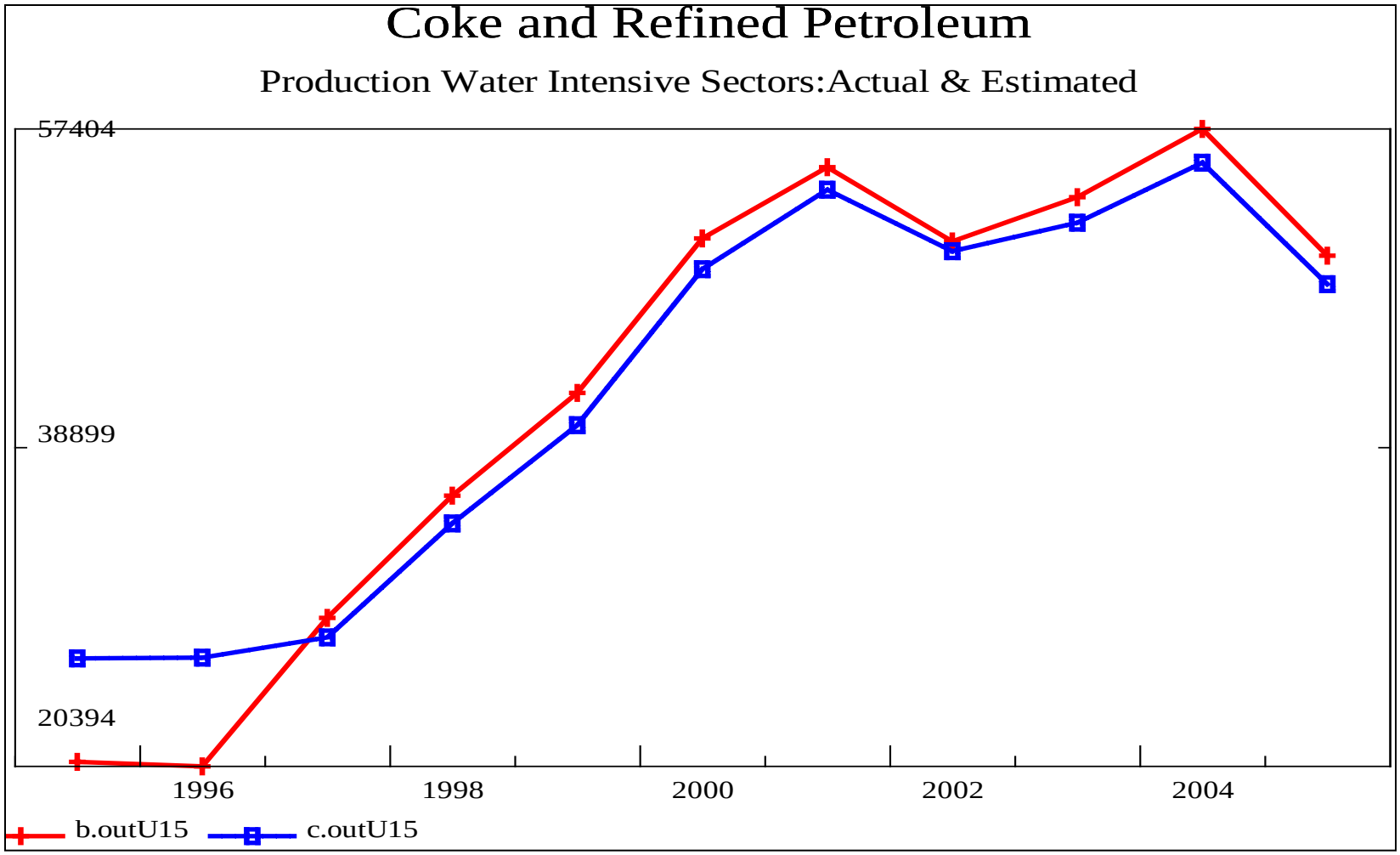
ACTUAL AND ESTIMATED SECTORAL PRODUCTION FOR SOME WATER INTENSIVE SECTORS (GOLD AND URANIUM ORE MINING)



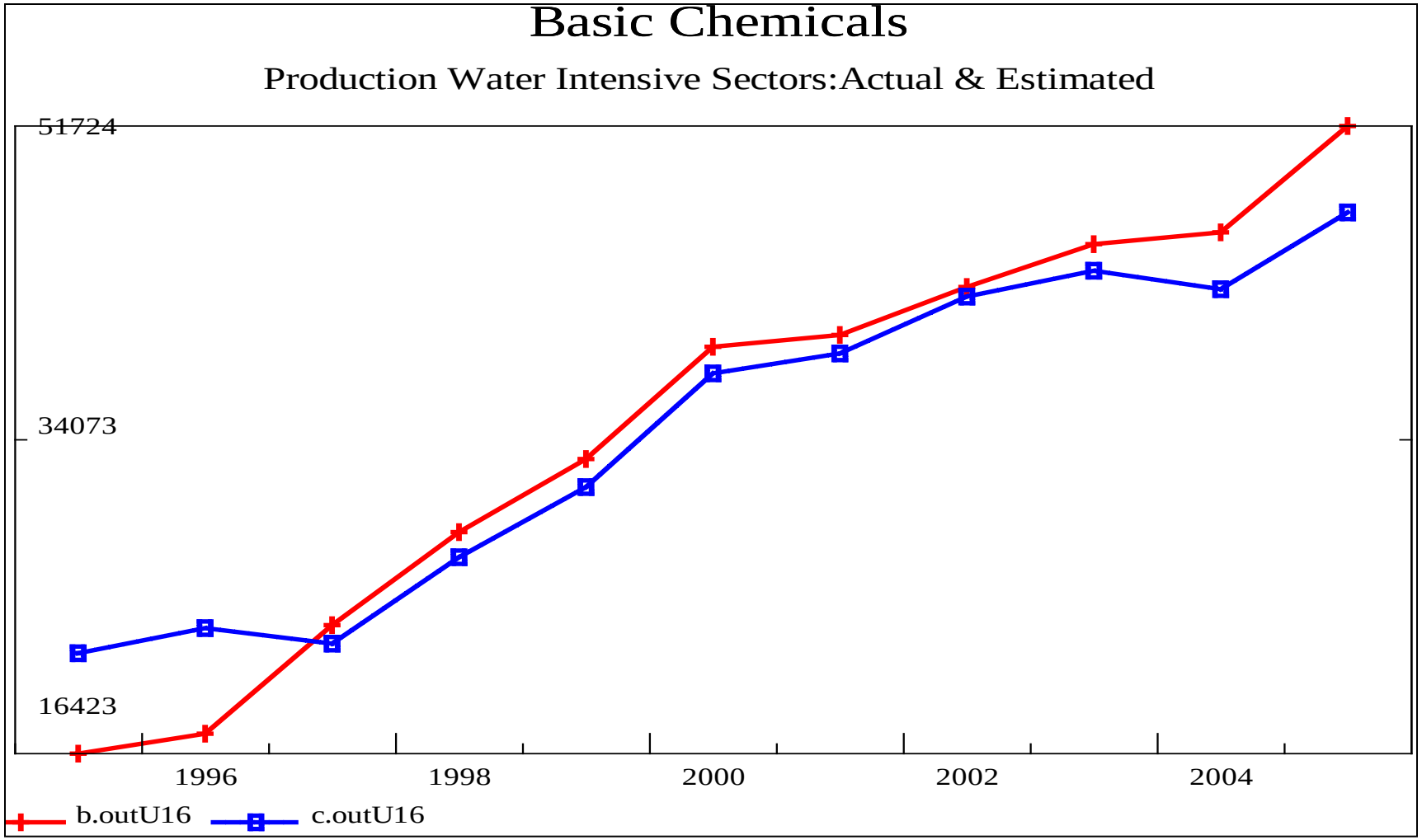
ACTUAL AND ESTRIMATED SECTORAL PRODUCTION FOR SOME WATER INTESIVE SECTORS (PAPER AND PAPER PRODUCTS)



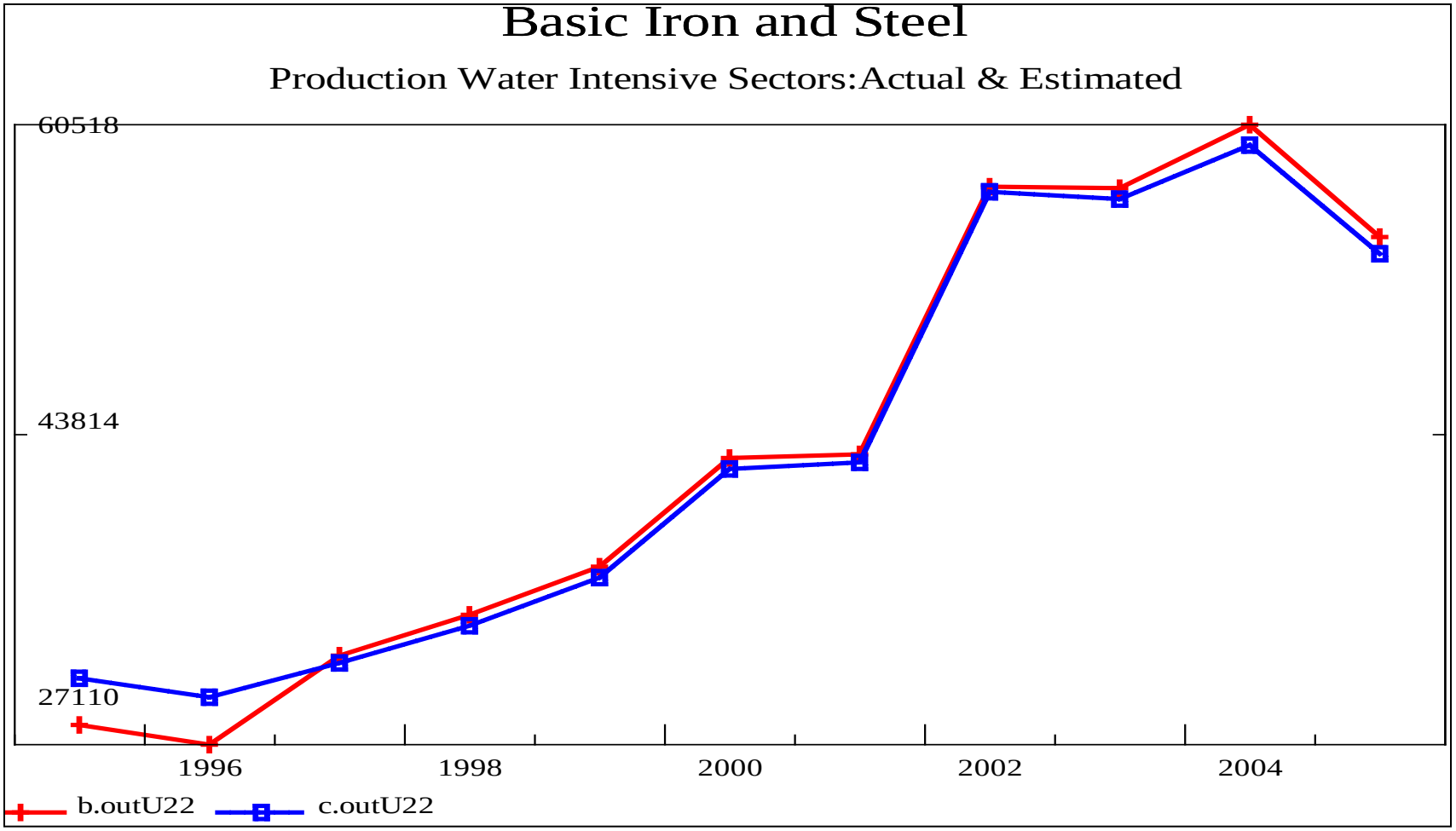
ACTUAL AND ESTIMATED SECTORAL PRODUCTION FOR SOME WATER INTENSIVE SECTORS (COKE AND REFINED PETROLEUM)



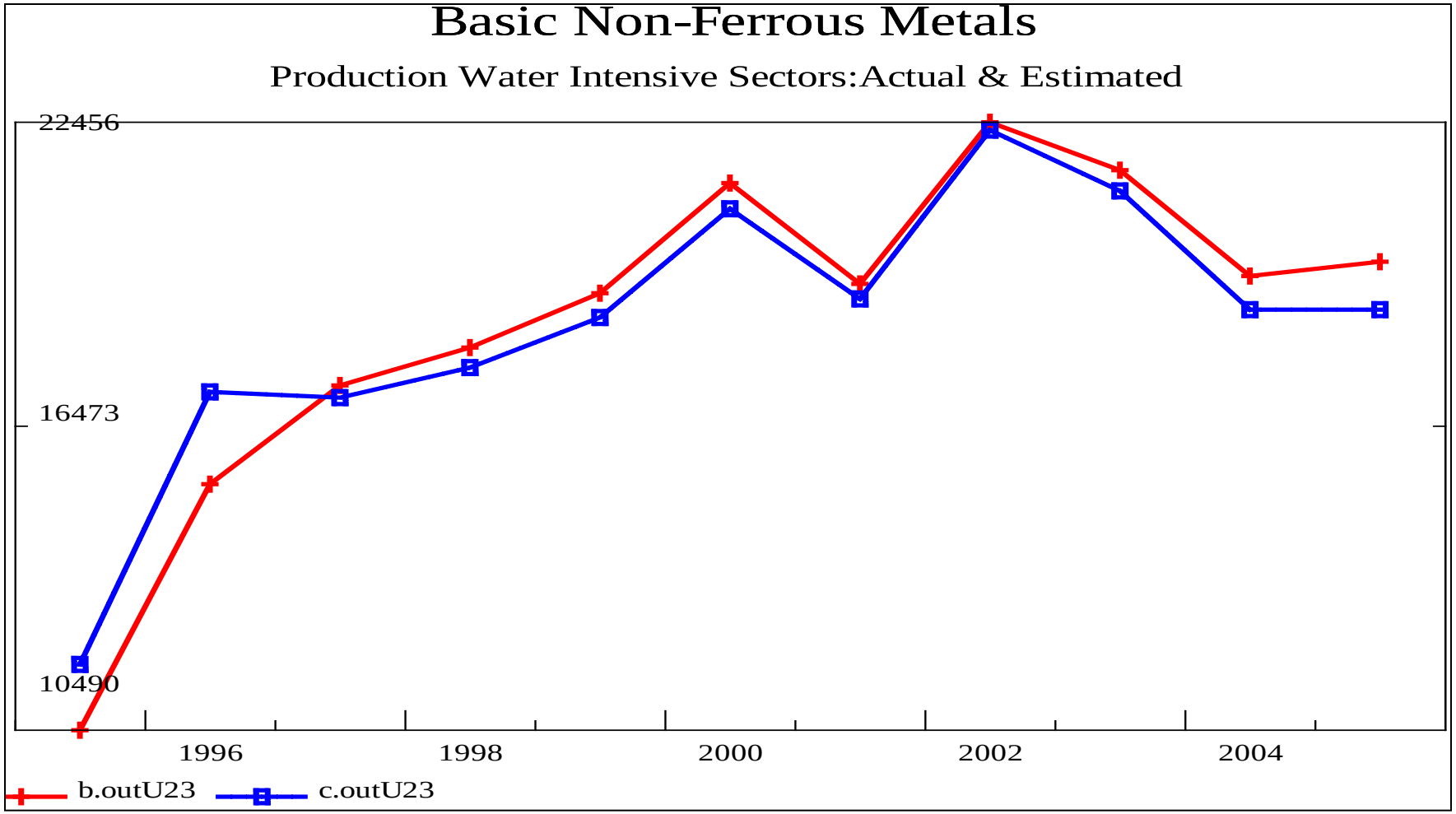
ACTUAL AND ESTIMATED SECTORAL PRODUCTION FOR SOME WATER INTENSIVE SECTORS (BASIC CHEMICALS)



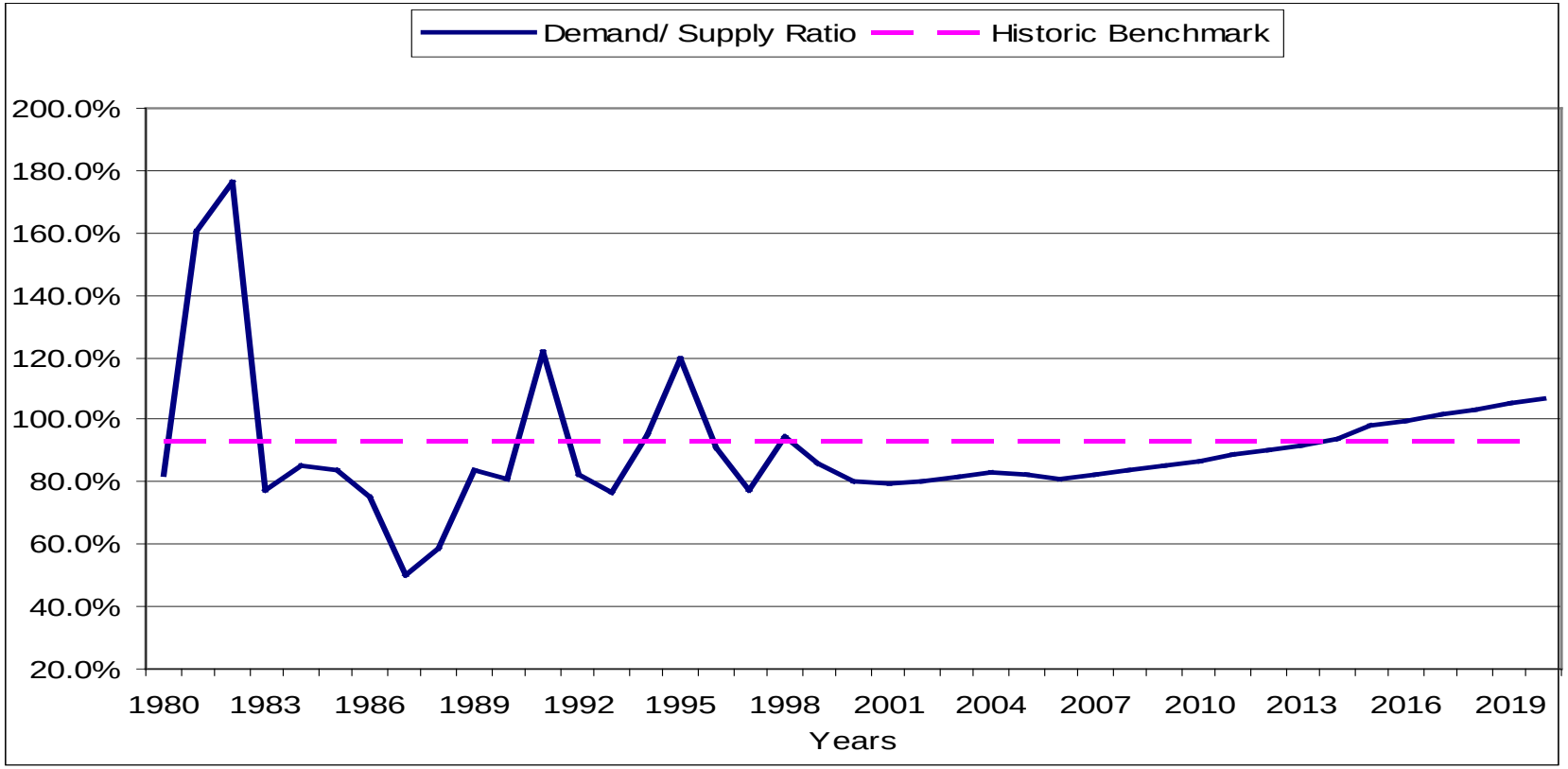
ACTUAL AND ESTIMATED SECTORAL PRODUCTION FOR SOME WATER INTENSIVE SECTORS (BASIC IRON AND STEEL)



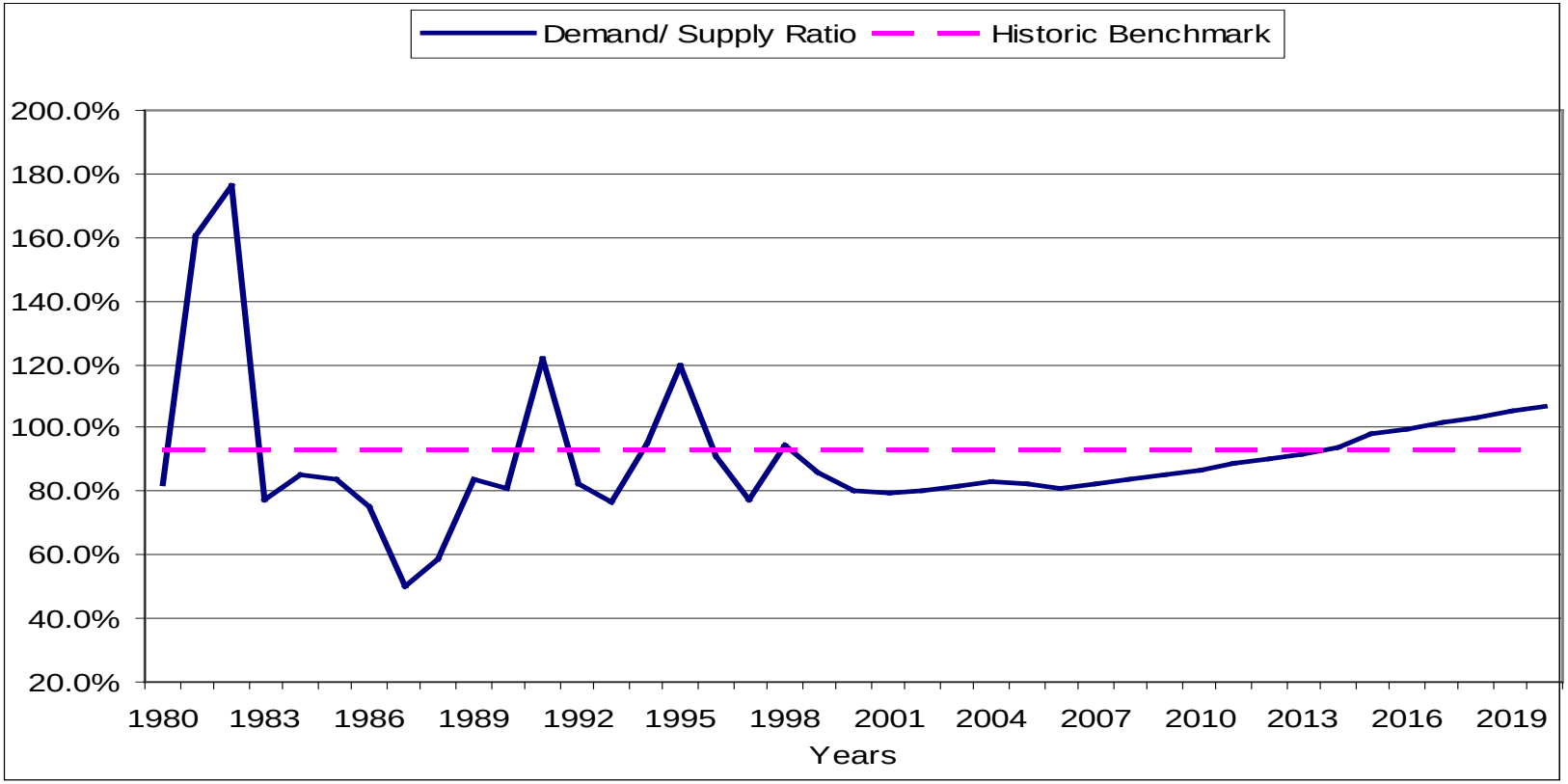
ACTUAL AND ESTIMATED SECTORAL PRODUCTION FOR SOME WATER INTENSIVE SECTORS (BASIC NON-FERROUS SECTORS)



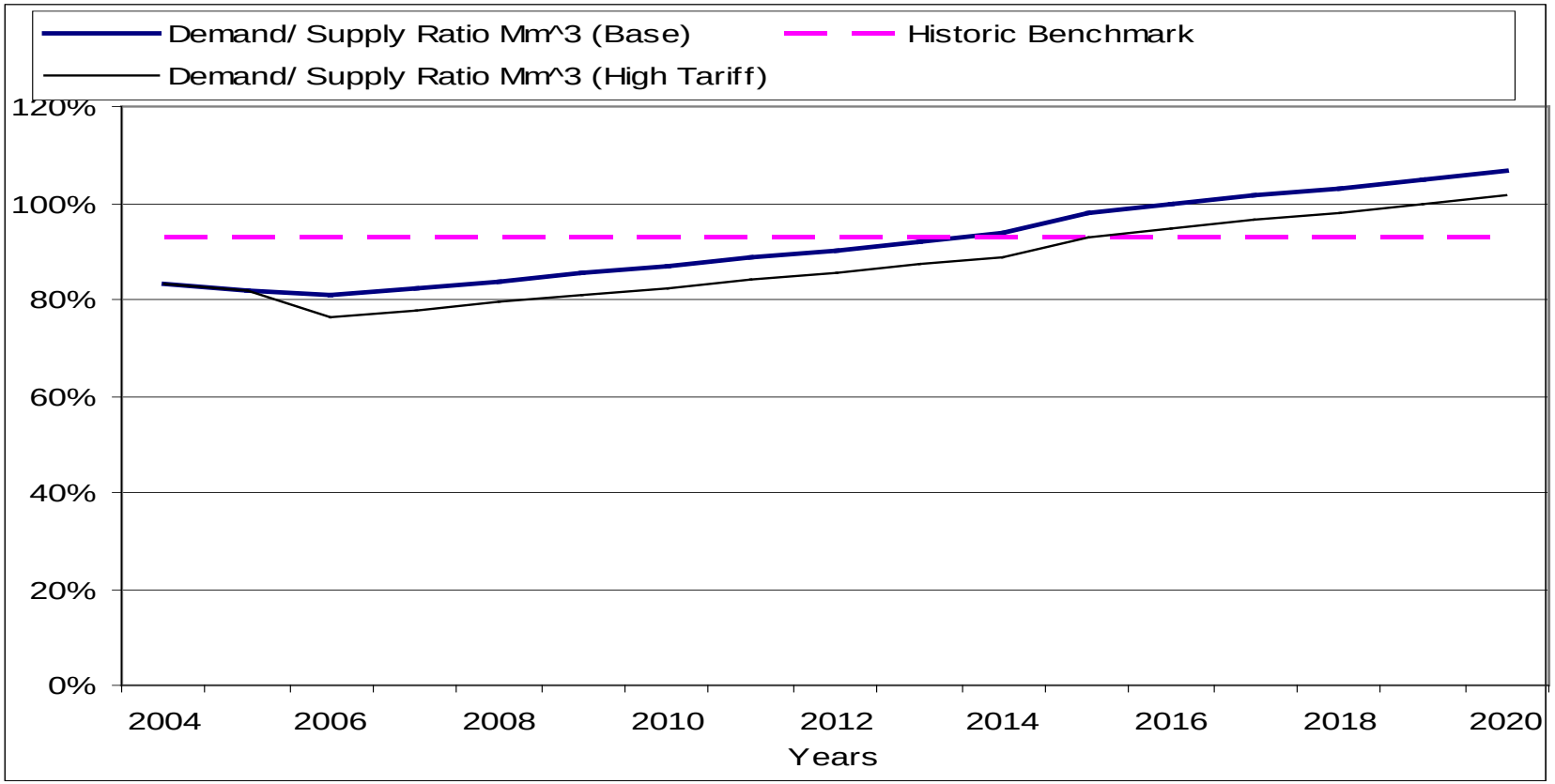
BASELINE SCENARIO



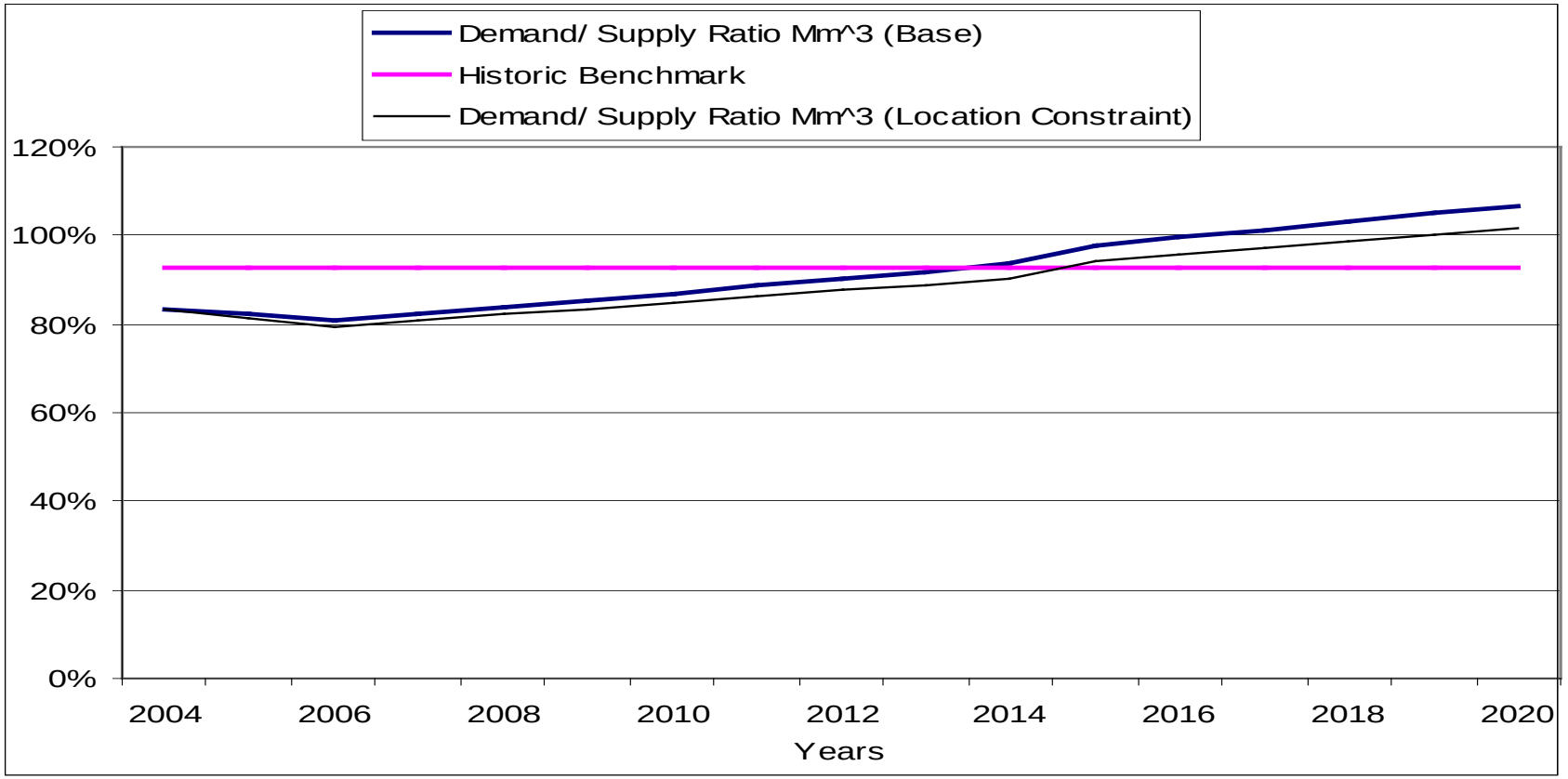
HIGH GROWTH SCENARIO



HIGH TARIFF SCENARIO



LOCATION CONSTRAINT SCENARIO



SUMMARY OF SCENARIOS – ECONOMIC IMPACT

			Scenario 2	Scenario 3
	Standard	Scenario 1	Water Tariff	Constraint of
Economic Levels	Scenario	High Growth	Increase	Location
Water (Million m3)	3 289	3 718	3 132	3 186
GDP (R million)	408 255	518 804	408 255	396 776
Employment (Number)	3 728 023	4 735 363	3 728 023	3 554 059

SUMMARY OF SCENARIOS – WATER EFFICIENCY

			Scenario 2	Scenario 3
	Standard	Scenario 1	Water Tariff	Constraint of
	Scenario	High Growth	Increase	Location
Level change of Economic Aggregate	**(Level)**	**(Increment)**	**(Increment)**	**(Increment)**
Water (Million m³)	3 289	429	-157	-103
GDP (R million)	408 255	110 549	n/a	-11 480
Employment (Number)	3 728 023	1 007 340	n/a	-173 964
Efficiency Criteria				
ΔGDP/Δwater (ΔMm³)	124	258	n/a	112
ΔEmpl/Δwater (ΔMm³)	1133	2 348	n/a	1 697

SUMMARY OF SCENARIOS – HISTORIC LEVELS OF AGGREGATES

				Scenario 2	Scenario 3
		Standard	Scenario 1	Water Tariff	Constraint of
		Scenario	High Growth	Increase	Location
Economic Aggregates	**2004**	**2020**	**2020**	**2020**	**2020**
Water (Million m³)	2 920	3 744	4 742	3 559	3 569
GDP (R million)	328 568	483 218	737 650	483 218	461 765
Employment (Number)	3 039 371	4 387 214	6 697 240	4 387 214	4 060 423

WAY FORWARD

- Appropriateness of IMS.
- Important results of IM/WSM Model application.
- Possible future steps to improve on model capabilities:
  - Expansion of regional reach of WSM.
  - Primary research needs on price elasticities of demand.
  - Location of model.
  - Data archiving.
- The way forward.