The Reliability of IGCC Power Generation Units

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Overview

- SPS's ORAP database
- Project goals and methodology
- Project schedule
- Some preliminary findings
- Conclusions

SYNGAS CONSULTANTS LTD.

- Specialists in syngas production from gasification and steam reforming
- Activities
  - Process integration
  - Project consultancy
  - Feasibility studies
  - Training seminars
  - Plant audits

Who is SPS? What is ORAP?

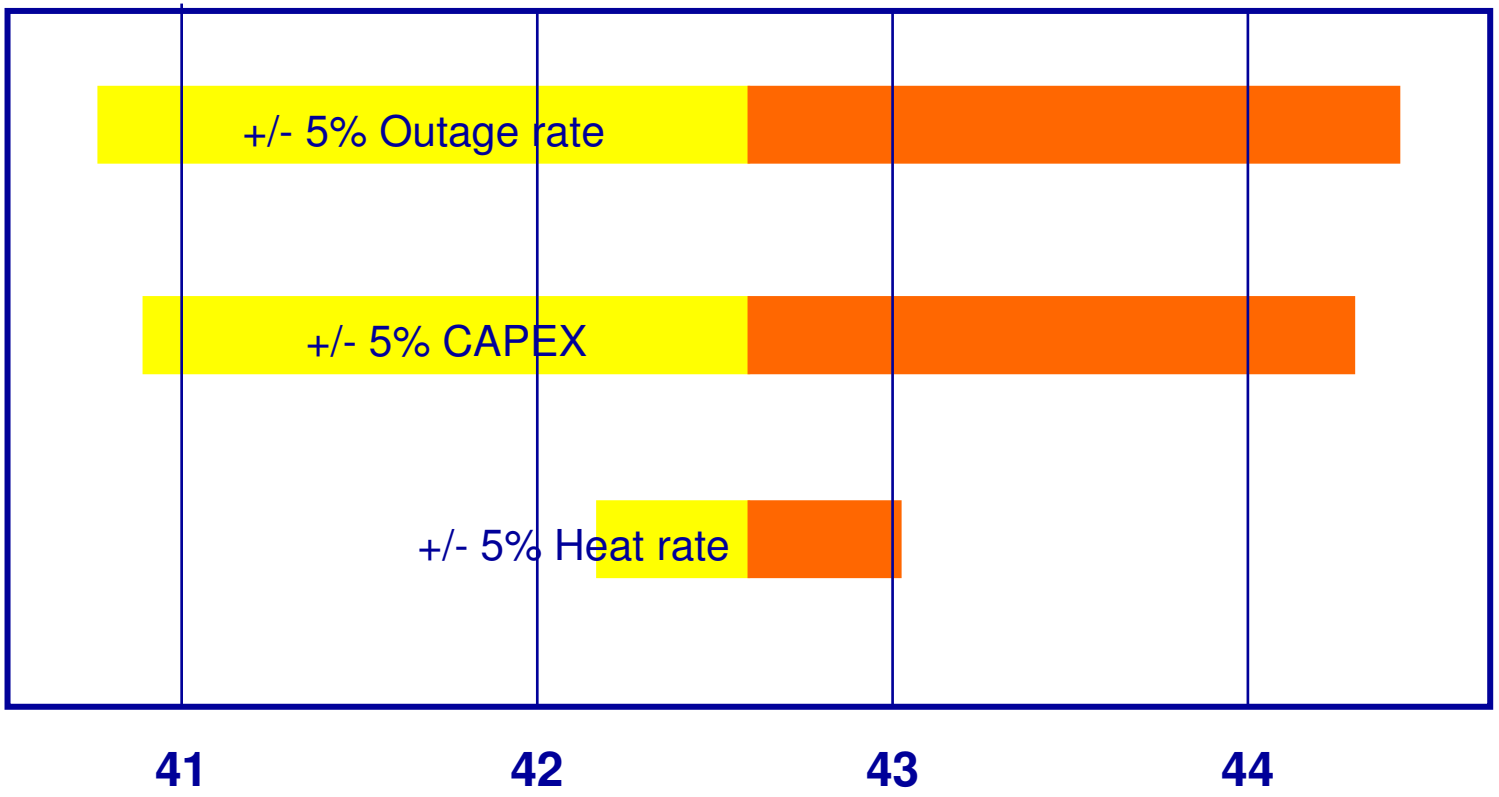
- An Information Technology & Reliability Engineering Company — Since 1987
- Support the Electric Power & Industrial Process markets…
- Recognized leader through ORAP… the Most Comprehensive Global Database in Our Industry … Unbiased & Accurate
  - Monitors Gas & Steam Turbine Plants . . . ISO 9001 Certified
  - Database in place since 1976
  - Over 2,000 Units Worldwide, Over 20,000 unit years of operating information available . . .
  - Strong Influence on Industry Standards . . . ISO 3977 Standard
- Provide "Knowledge Based" Engineering Services & Software Products focused on:
  - Data analysis and evaluation… Availability & Reliability
  - Knowledge transfer… Benchmarking & "Best Practices"
  - Remote Monitoring… Real-Time Data for Maintenance & Life Planning

Reliable Data for Effective Decision Support through ORAP

Where is IGCC now?

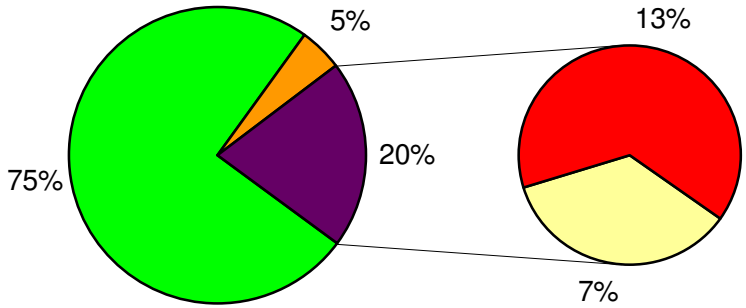
- ✓ Superior environmental performance
- ✓ Higher efficiency
- ➢ Installed cost
- ? Reliability

Effect of Reliability

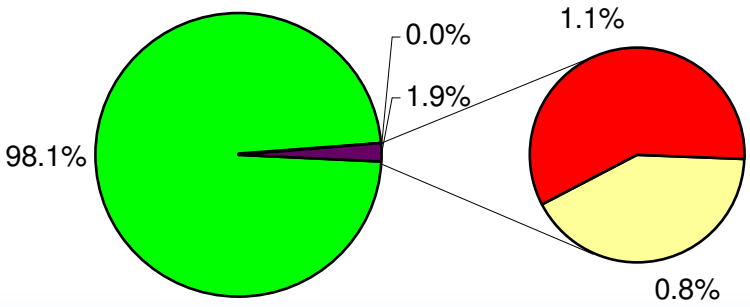


Current Reliability Performance

Plant A

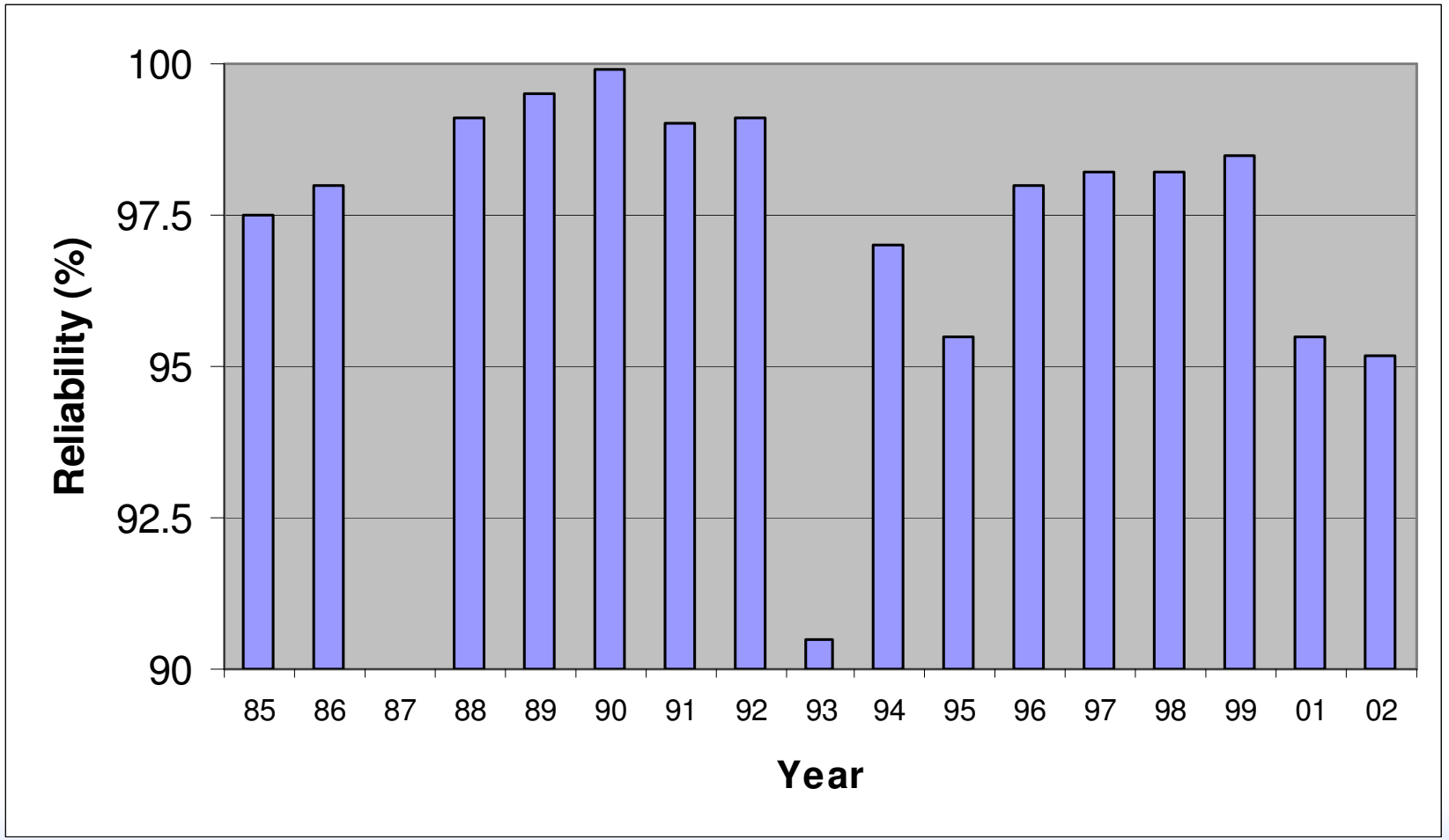


Plant B



- On stream
- Not required/despatched
- Planned outage
- Unplanned outage

Reliability - BP, Gelsenkirchen



Source: Laege, 2002

Project Goals

- Establish reliable, evidence-based expectation for IGCC availability
  - Using public domain reliability data
  - Using actual plant data
  - Using common definitions
- Update prediction models with “best-of-class” plant data
- Identify strengths and weaknesses
  - Inside/outside core gasifier unit

Public domain literature

Potential Participating Plants

- 14 IGCCs
  - 8 solid feedstock
  - 6 liquid feedstock
- 11 chemical and refinery plants
  - 3 solid feedstock
  - 8 liquid feedstock

Include some chemical plants

- Increases sample for improved validation
- Provides representative data on
  - Oxygen supply
  - Gasification
  - Gas treatment
- Ammonia plants will supply data on CO_2 capture (and compression where integrated urea plant)

Project Schedule

✓ Data base structure and codes	July 2005
✓ Evaluate public domain data	End Aug 2005
✓ Preliminary findings	Oct 2005
• Plant interviews	ongoing
• Preliminary report	June 2006
• Detail evaluation & prediction model	End 2006

Some preliminary findings

- Air Separation Units
- Gasification Units
- Acid Gas Removal/ Sulfur Recovery Units
- Combined Cycle Units
- Overall Picture

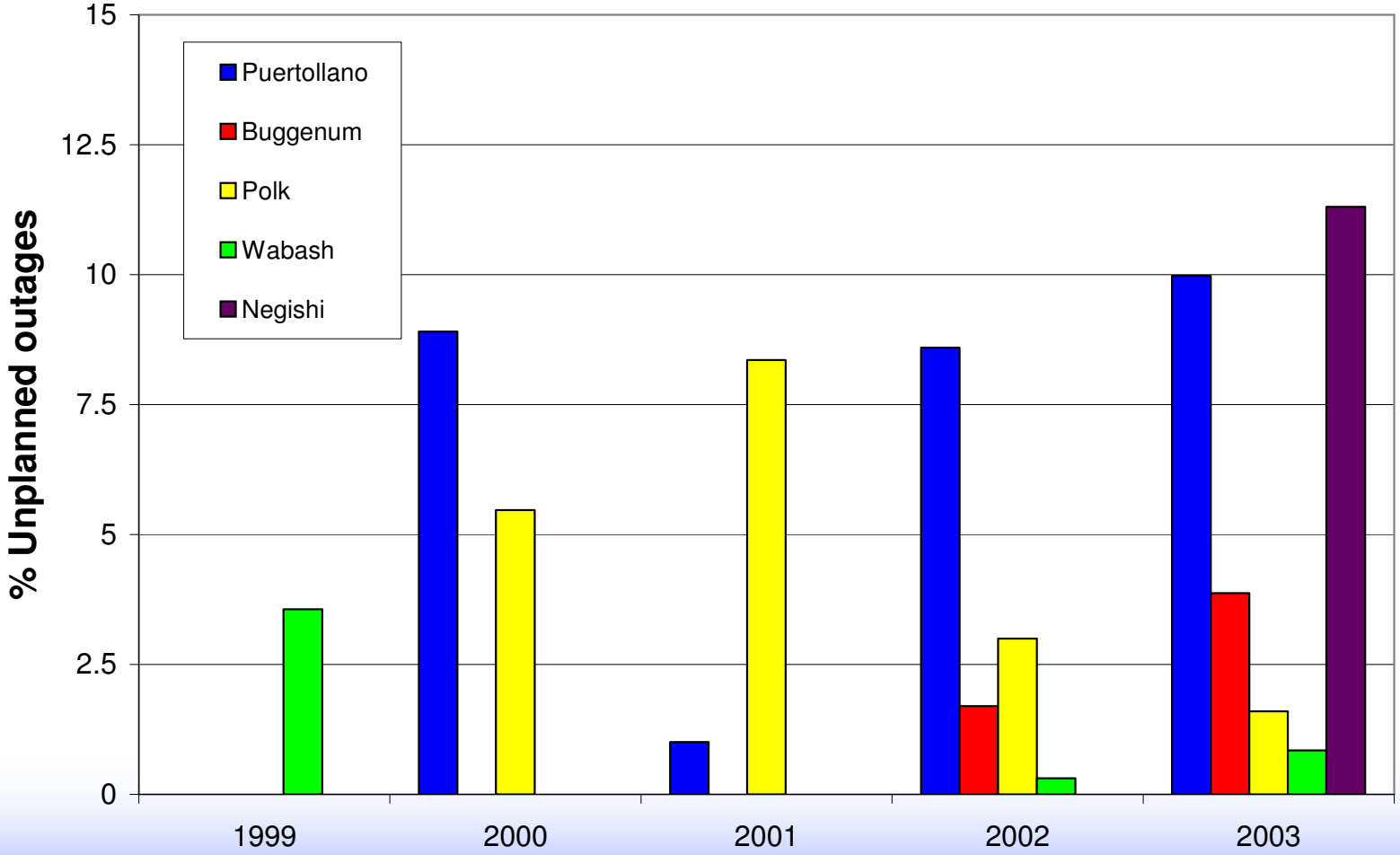
NERC GADS Data 2000-2004

	Service Factor (%)	Capacity Factor (%)	Availability Factor (%)
Gas-fired boilers	40.0	23.1	87.5
Oil-fired boilers	41.1	27.5	86.5
Coal-fired boilers	83.2	71.9	87.6
Aero-derivatives	5.1	3.7	93.0
Single Cycle GTs	4.3	3.8	93.1
Combined Cycle GTs	Not available	Not available	Not available

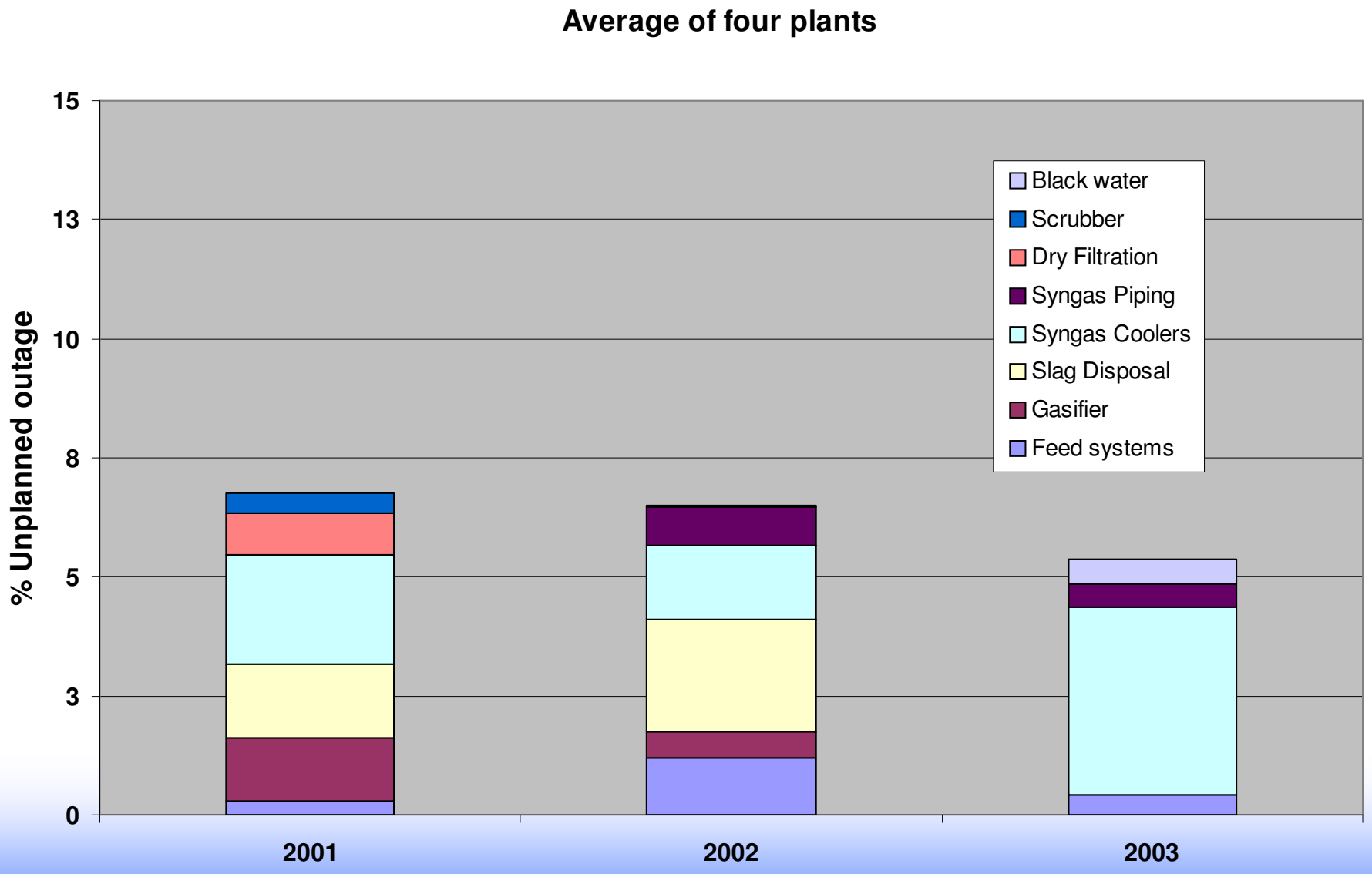
Source: DellaVilla, 2004

ASU: Public Domain Data

Unplanned outages

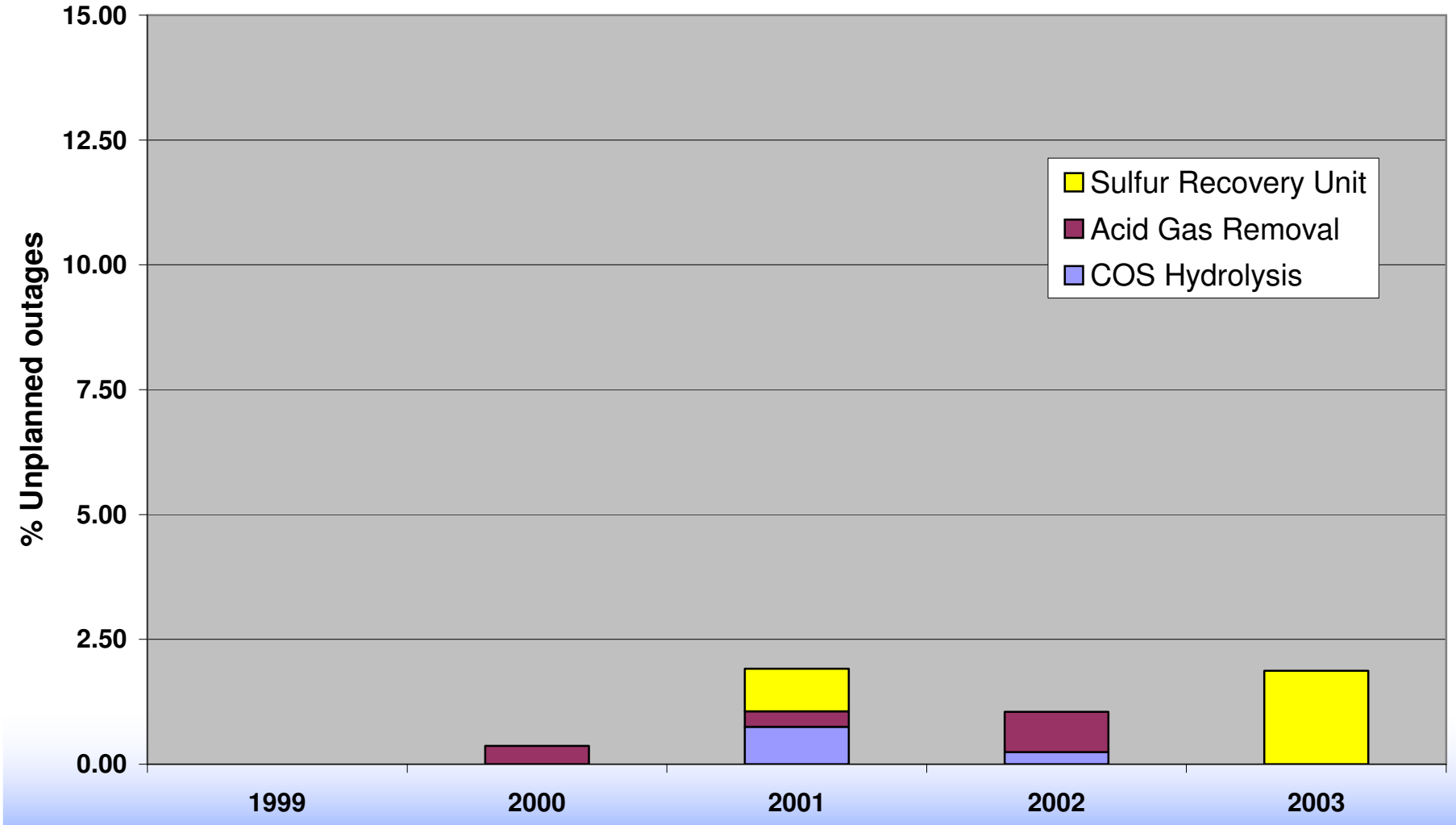


Gasification

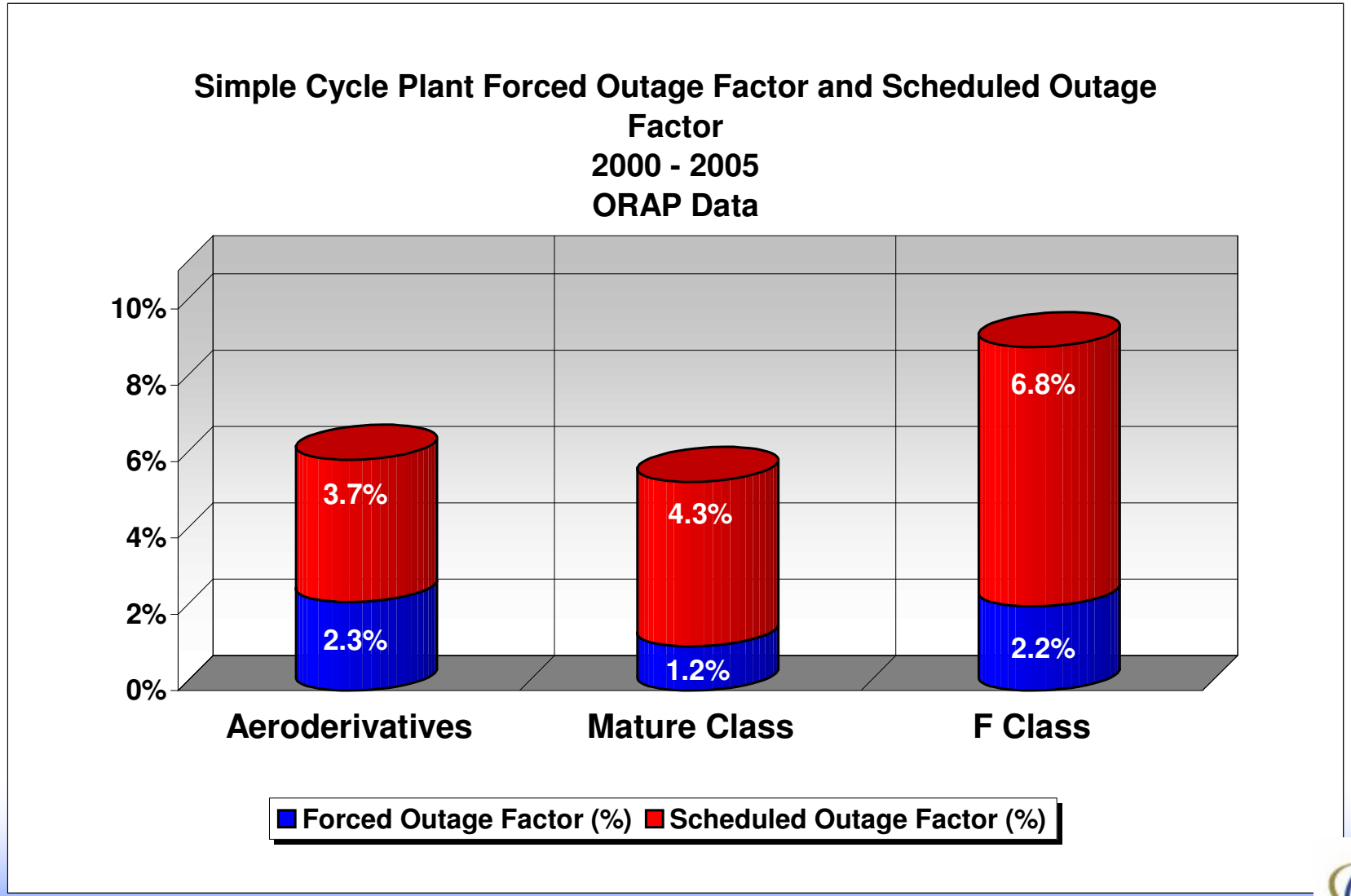


Acid Gas Removal

Average of Four Plants



ORAP – Forced and Scheduled Outage



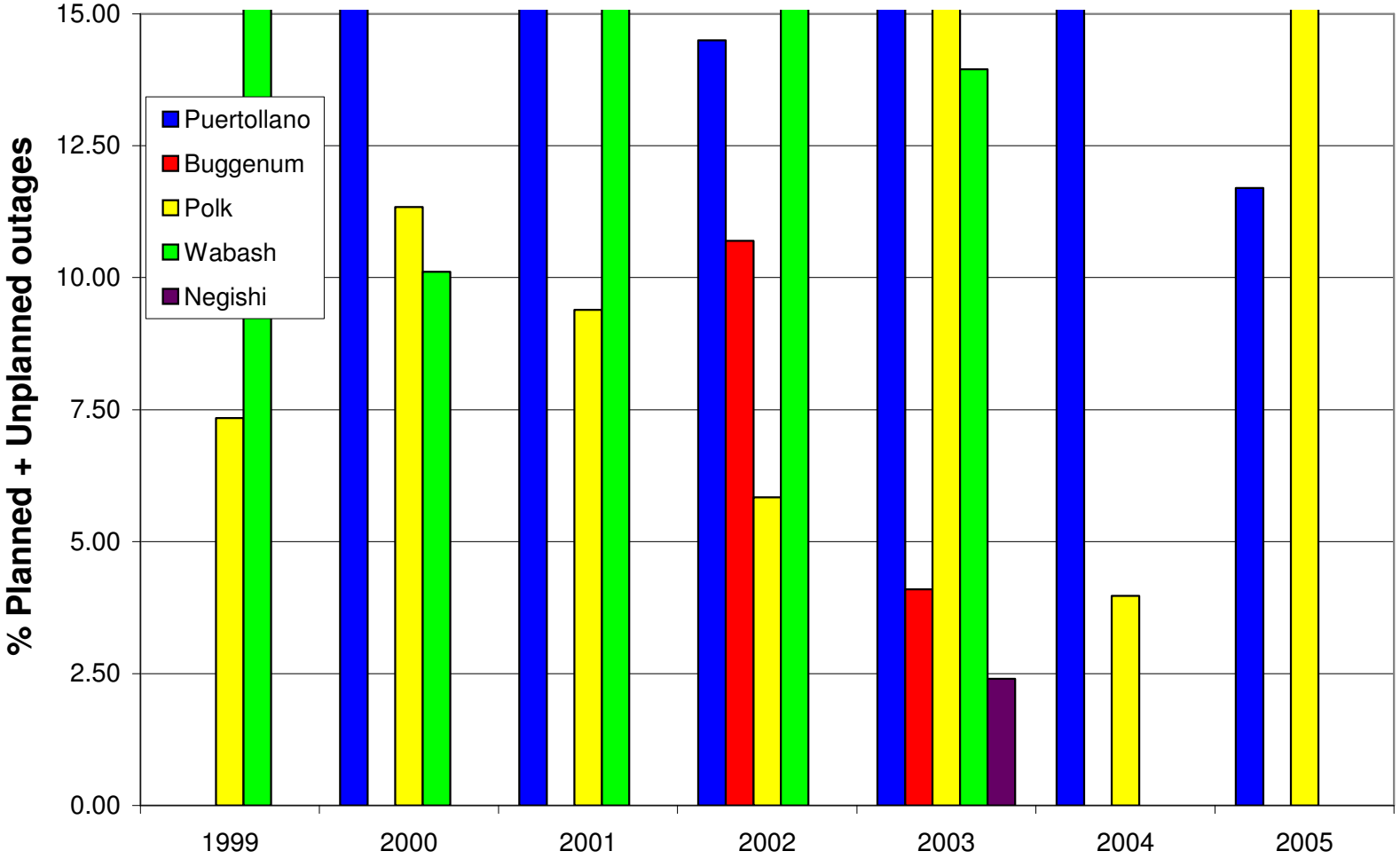
ORAP Data 2000-2005

Simple Cycle Plant Statistics

	Service Factor (%)	Availability (%)	Reliability (%)
Aeroderivative	34.7	92.1	96.5
Utility			
Non-Utility	55.3	94.3	97.9
E-Class	18.2	94.1	98.8
Utility			
Non-Utility	62.0	95.0	99.0
F-Class	60.6	90.1	97.6
Utility			
Non-Utility	55.2	91.7	98.1

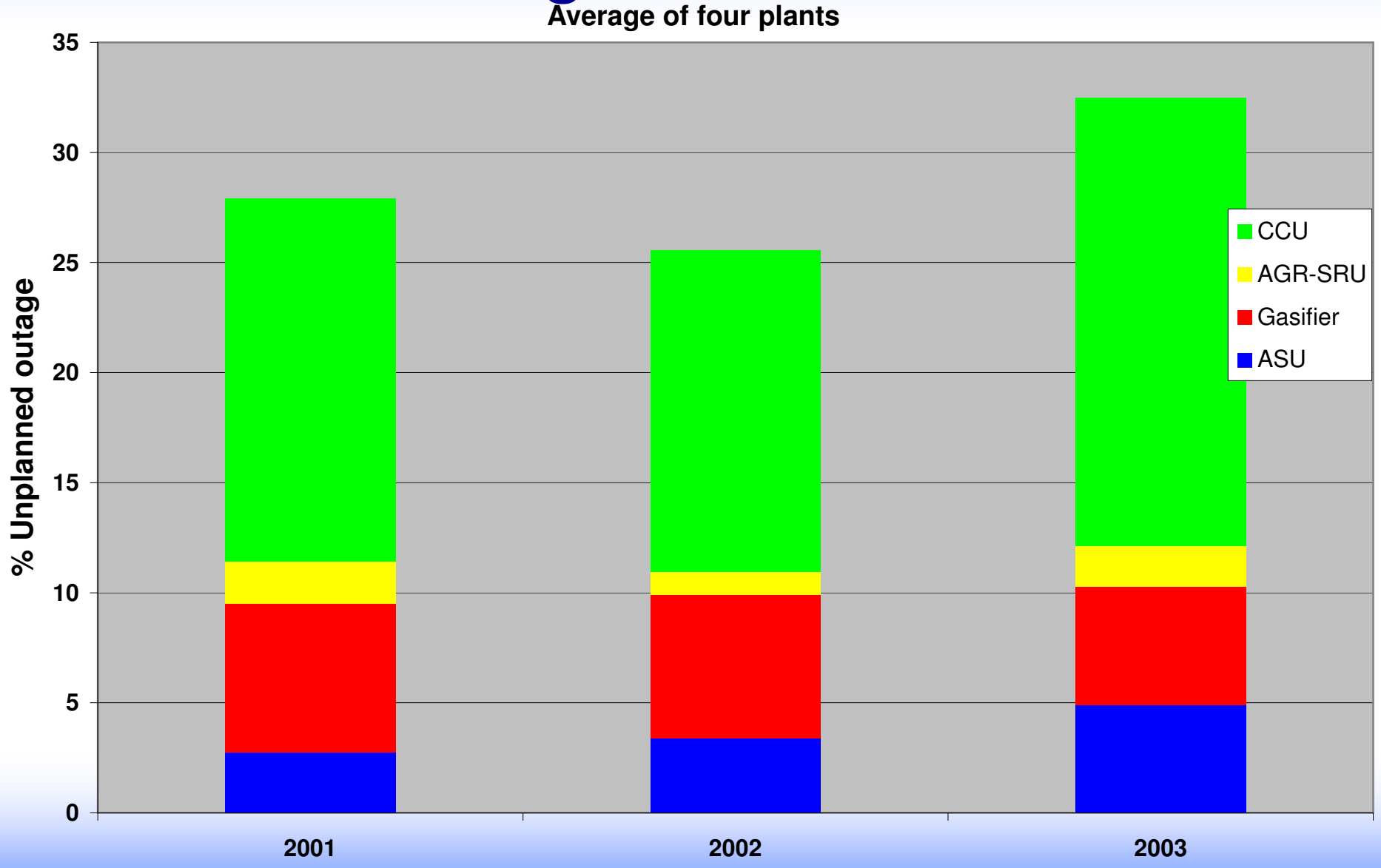
Source: DellaVilla, 2004

Power Block: Public Domain Data



Note: Wabash data estimated from "Syngas not required"
Data for some plants/years incomplete

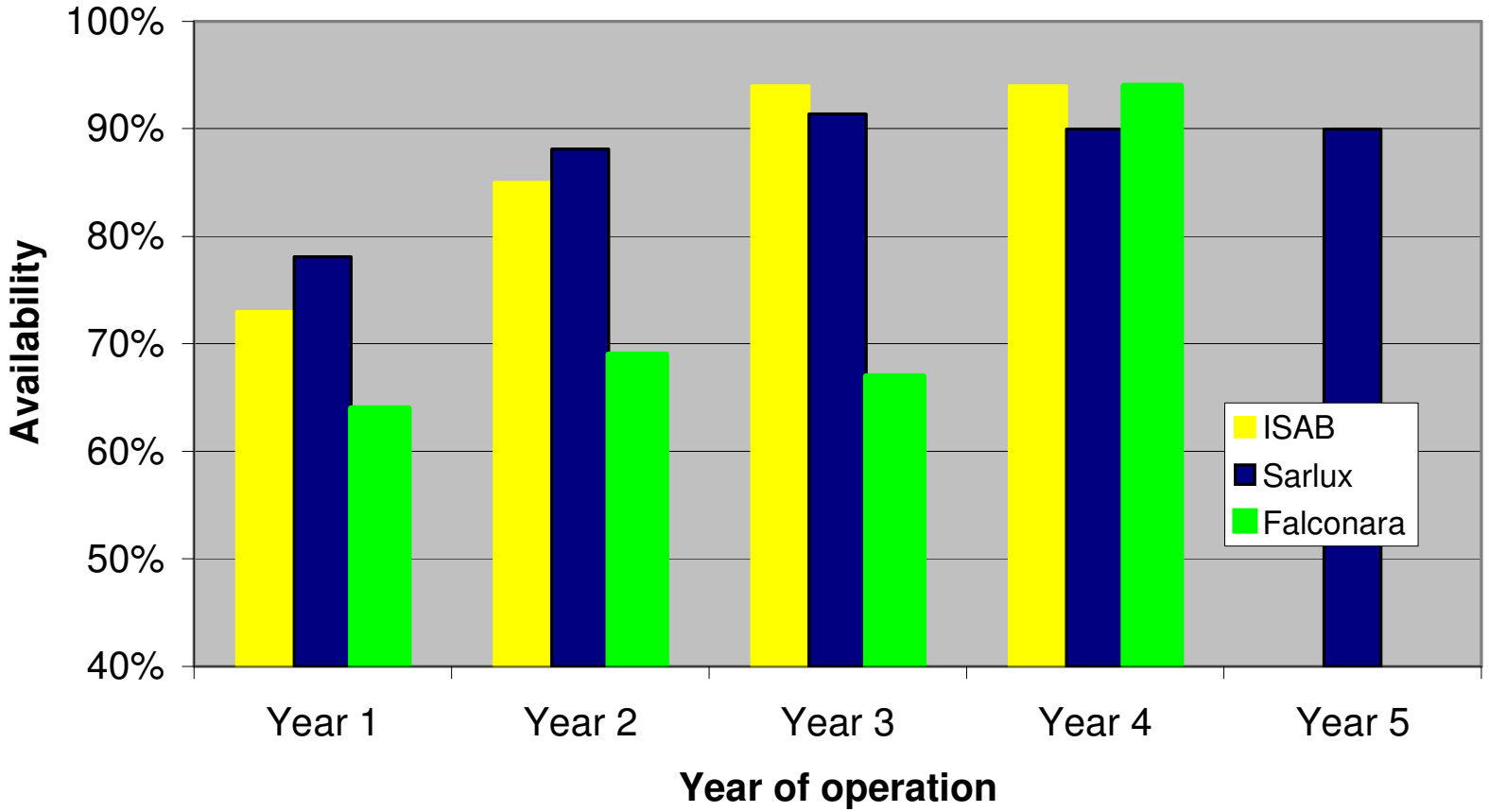
Overall Outage Data – Coal IGCCs



Italian Resid IGCC Configurations

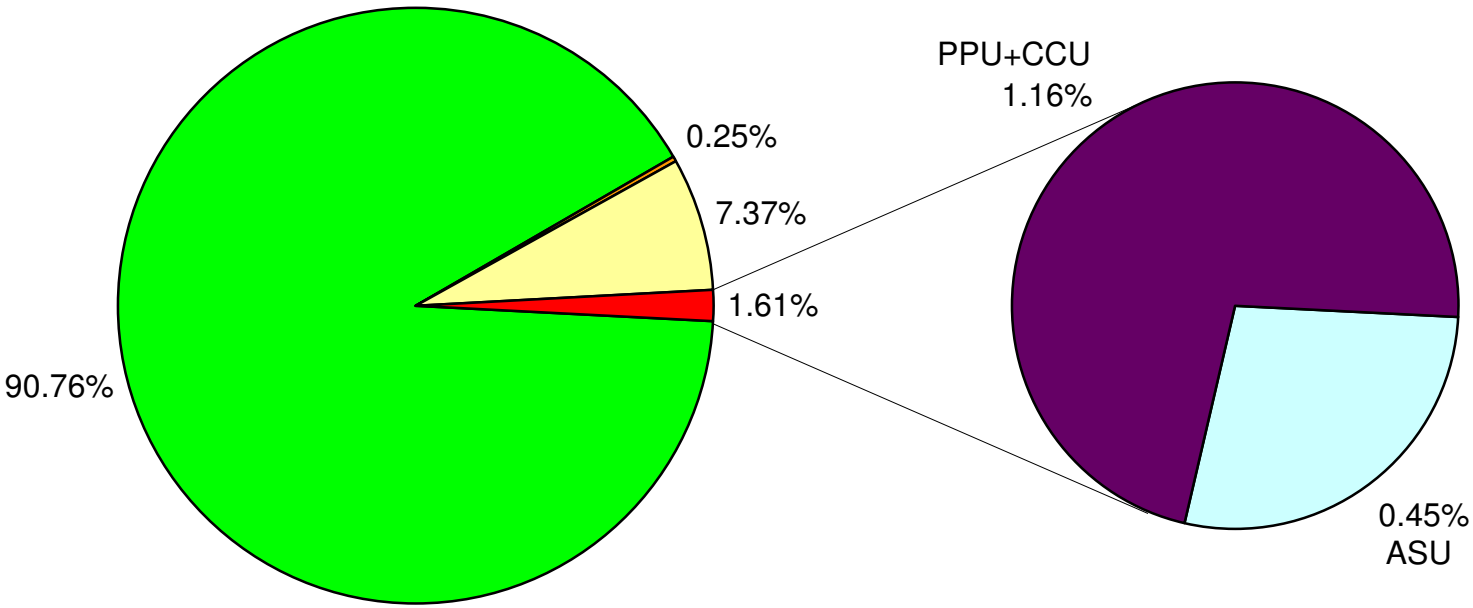
	ISAB (Sicily)	Sarlux (Sardinia)	api Energia (Falconara)
ASU Integration	None (Air Liquide)	None (Air Liquide)	None
Gasifier Feed rate Pressure	GE (2 gasifiers) 3168 t/d 67 bar	GE (3 gasifiers) 3559 t/d 38 bar	GE (2 gasifiers) 1440 t/d ~60 bar
AGR	MDEA	Selexol	Selexol
Gas turbine	Siemens 2 x V94.2K	GE 3 x STAG 109E	Alstom 1 x 13E2
Power output	512 MW	551 MW	241 MW
Co-products		40,000 Nm^3H_2/h 180 t/h steam	65 t/h steam

Performance of Italian Resid. IGCCs



Sources: Collodi,2003; Arienti, 2005; Allevi, 2006, Jaeger, 2006

Sarlux IGCC 2002 Operation



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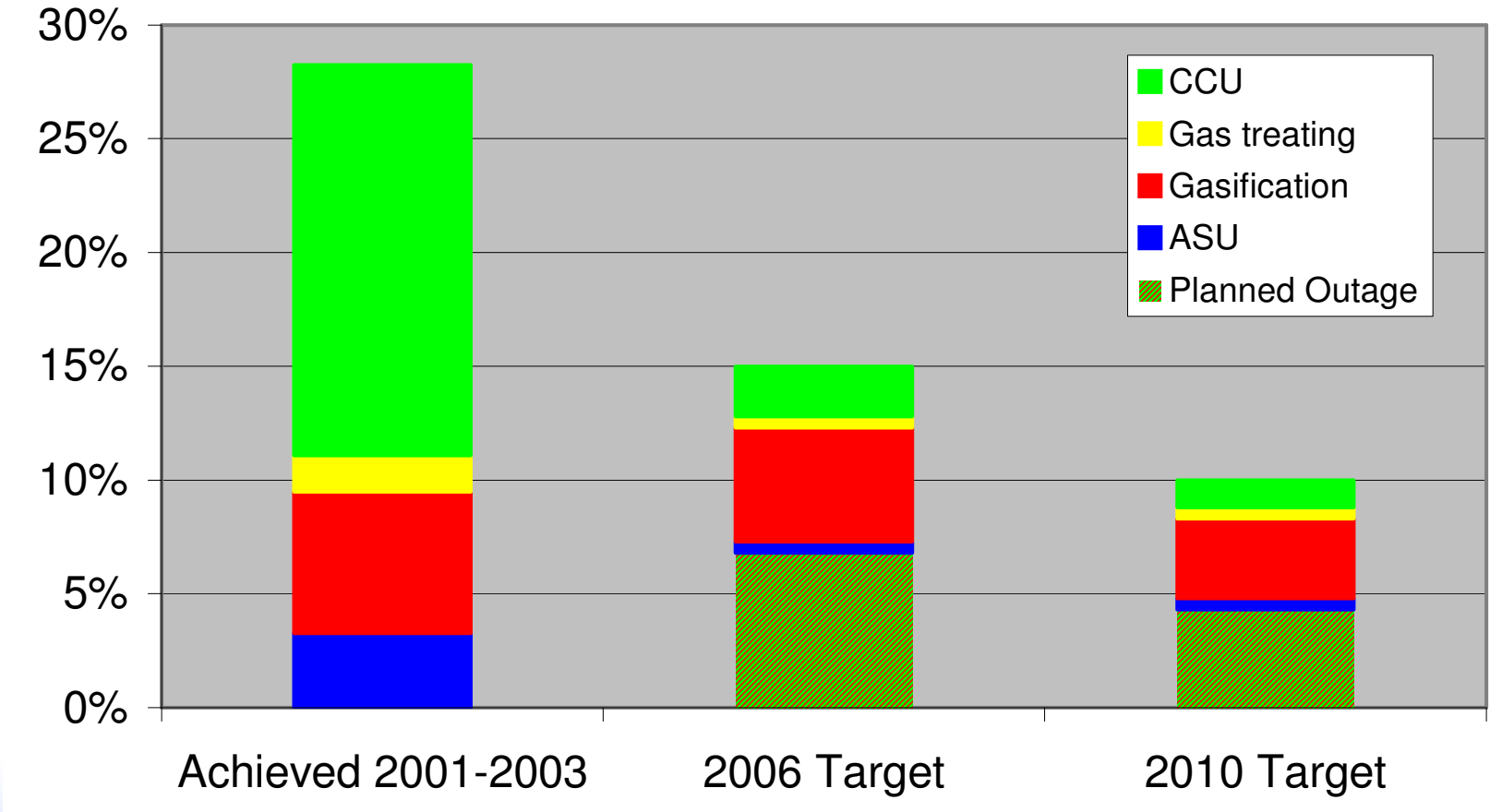
Source: Collodi, GTC 2003

Improvement Targets for Coal IGCCs



Summary

- “Maybe folks are now beginning to realize that there is more to reliability than just a spare gasifier.”
- The introduction of advanced technology anywhere in the system has its attendant risks.
- Attention to detail in “standard” auxiliary units can contribute substantially to IGCC reliability.
- ORAP RAM tracking can help identify the areas for improvement
- Implementation of “lessons learned” at all levels is key to success.

Thank you

Any questions?

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http://www.higman.de/gasification/index.htm