



SATURN

ATKINS



ITS

# 2009 User Group

SATURN-CASSINI

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# SATURN CASSINI

## Balancing convergence targets

### Background

- Developed to **significantly** reduce SATURN model runtimes when used within Variable Demand Models
- Requirement emerged from model developed for TIF Greater Bristol
- Idea around for a long time (says DVV)!

### Approach:

- Convergence targets track the level of convergence **achieved** within the Demand Model
- VB program to enable SATURN network convergence parameters to be changed 'on the fly'
- User-defined setting criteria

### Performance:

- Delivers substantial reduction in model runtimes
- Extended to work with DIADEM
- Compatible with SATURN Multi-Core



Source: [saturn.jpl.nasa.gov](http://saturn.jpl.nasa.gov)

# GBMF – Overview

Developed on behalf of West of England Partnership Office

Provide common modelling approach across the Greater Bristol Area

Develop **three** transport models fully compliant with:

- TAG Unit 3.10 – Variable Demand Modelling
- TAG Unit 3.11 – Modelling Public Transport Schemes
- TAG Unit 3.12 – Modelling & Appraisal for Road Pricing

Provide a range of standardised forecasting scenarios

- TAG Unit 3.15 - Treatment of Uncertainty in Forecasting

Technical liaison with Department for Transport

Support for TIF & Major Scheme Bids

# Standard Modelling Tools

## Highway Models



SATURN v10.8.17, .21, .22

## Public Transport



EMME2 v9.3

## Demand Model



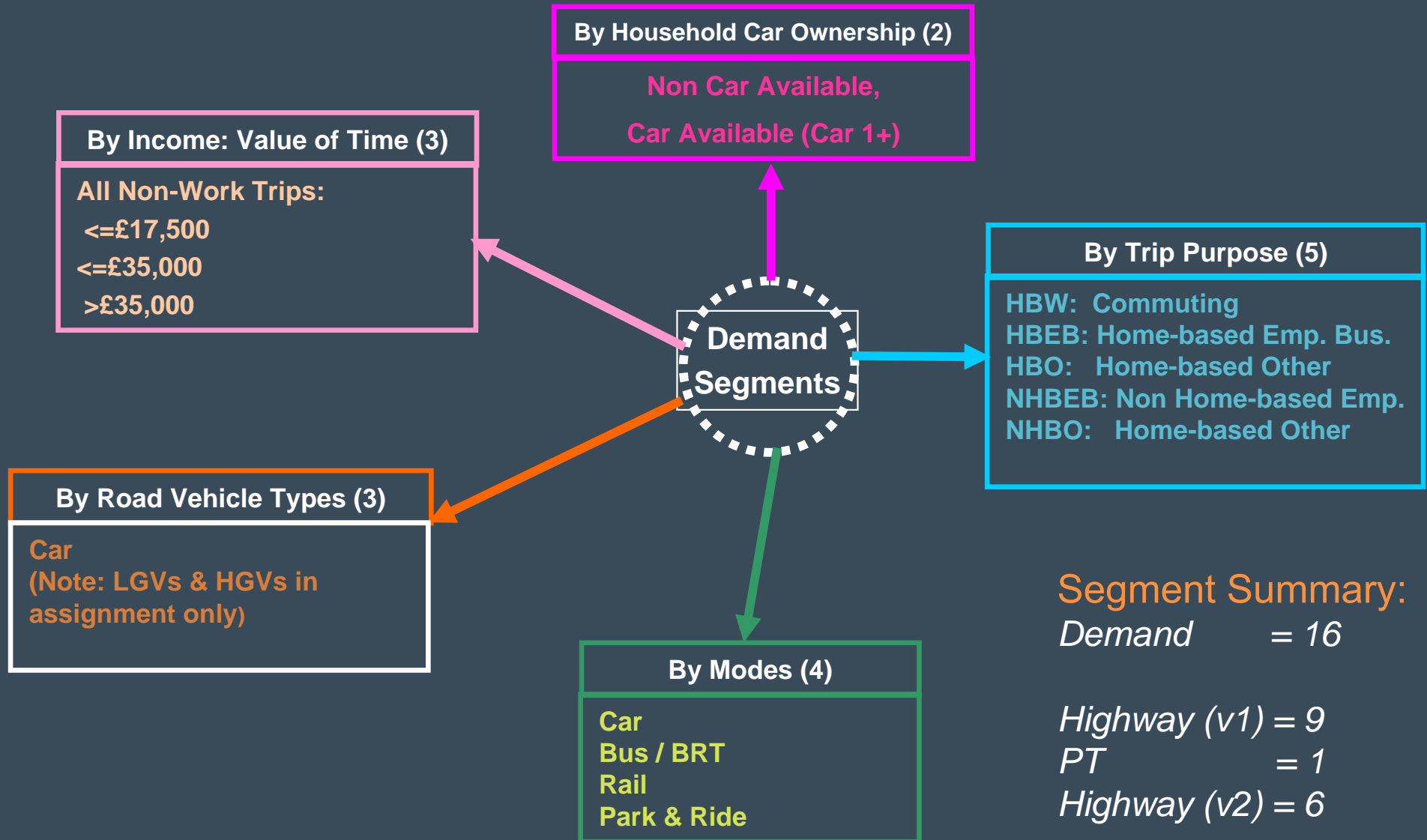
EMME2 v9.3

## Reporting

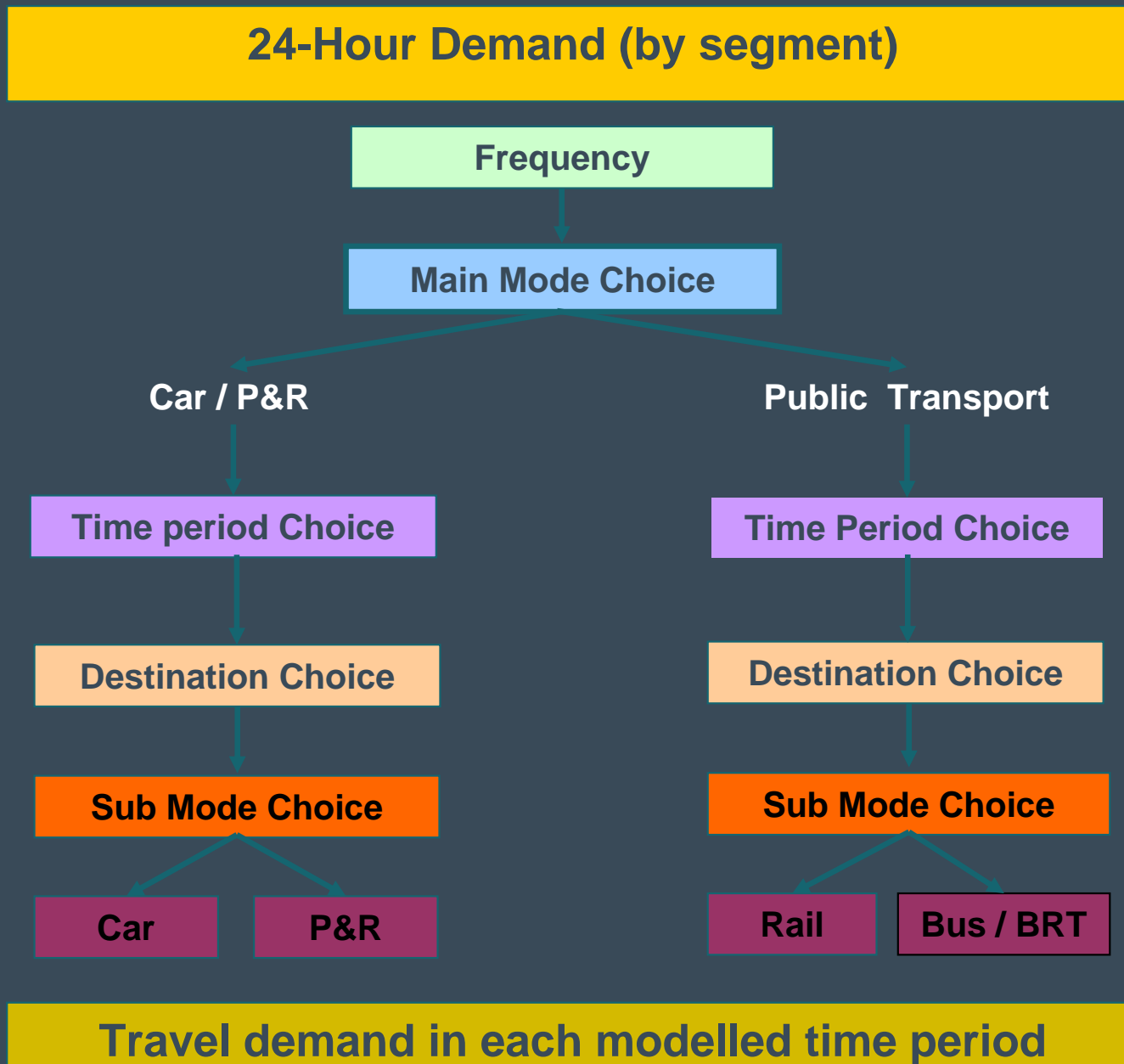


ArcView v9.2 & MapInfo v9.0

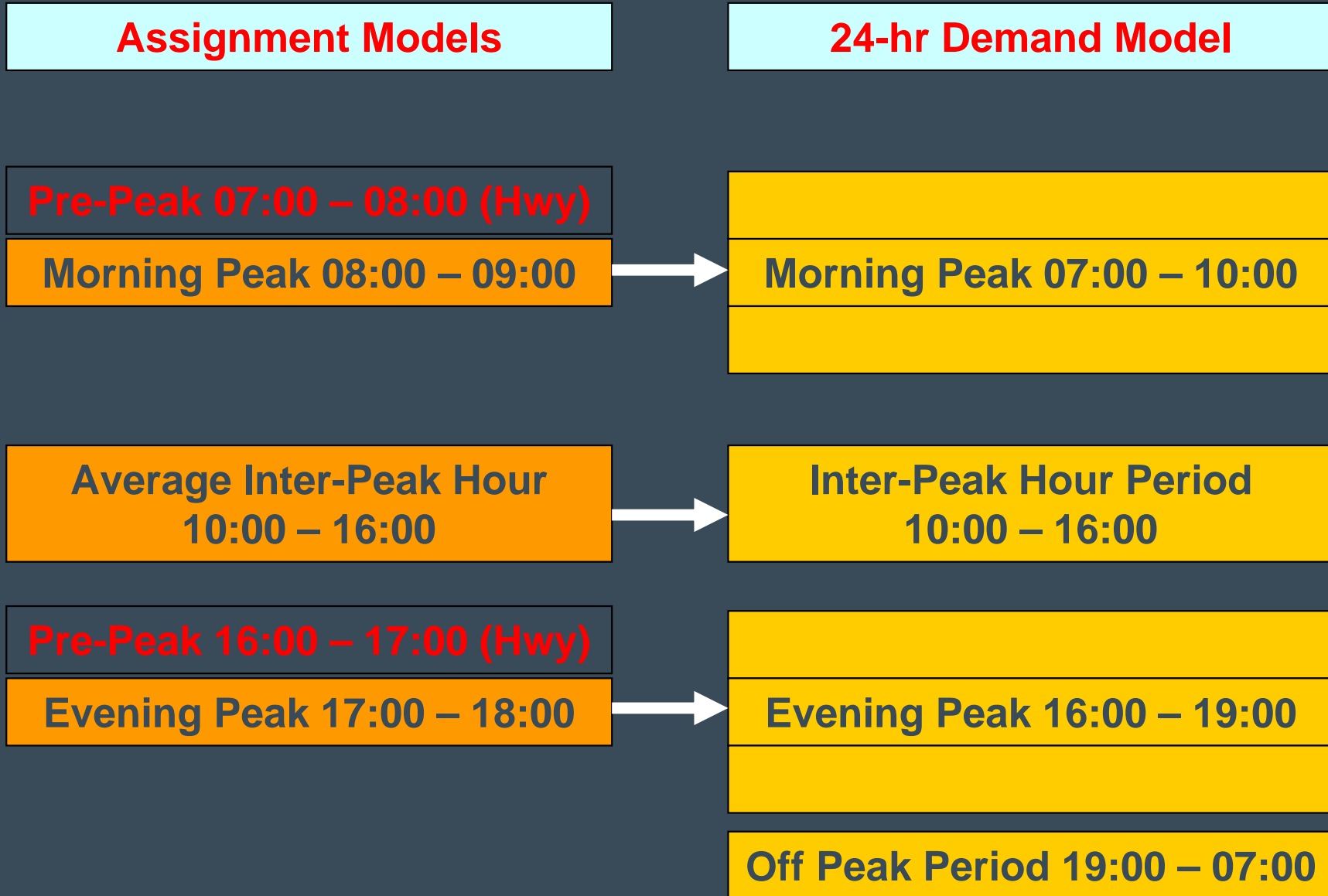
# Travel Choices and Behaviour (ii)



# Travel Choices and Behaviour (iii)



# Travel Choices and Behaviour (iv)



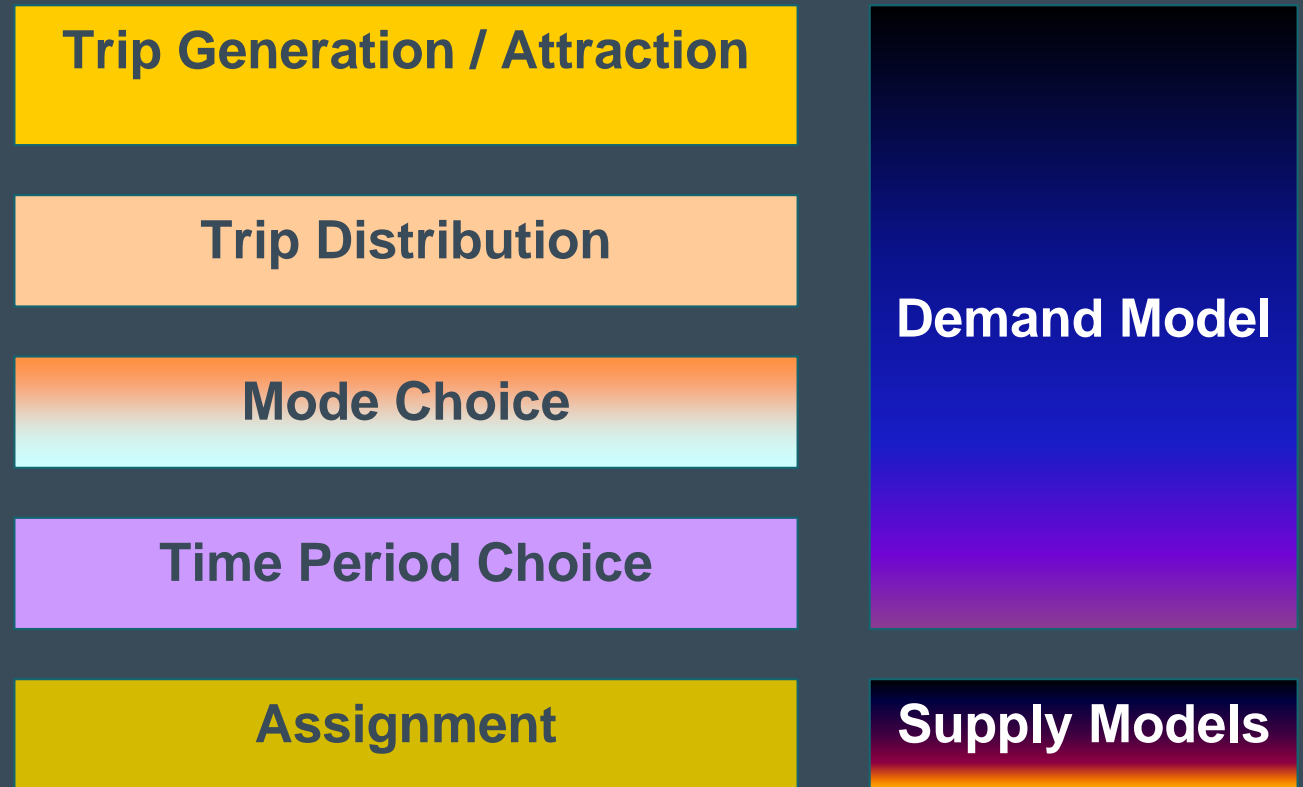
# Travel Choices and Behaviour (i)

Transport models attempt to represent and forecast travel decisions and behaviour:

## In Real Life

- to own a car
- to make a trip
- for which purpose
- to where
- by which mode
- at which time
- by which route

## Components of the Transport Model



# GBMF – Model Runtimes

## Convergence Targets:

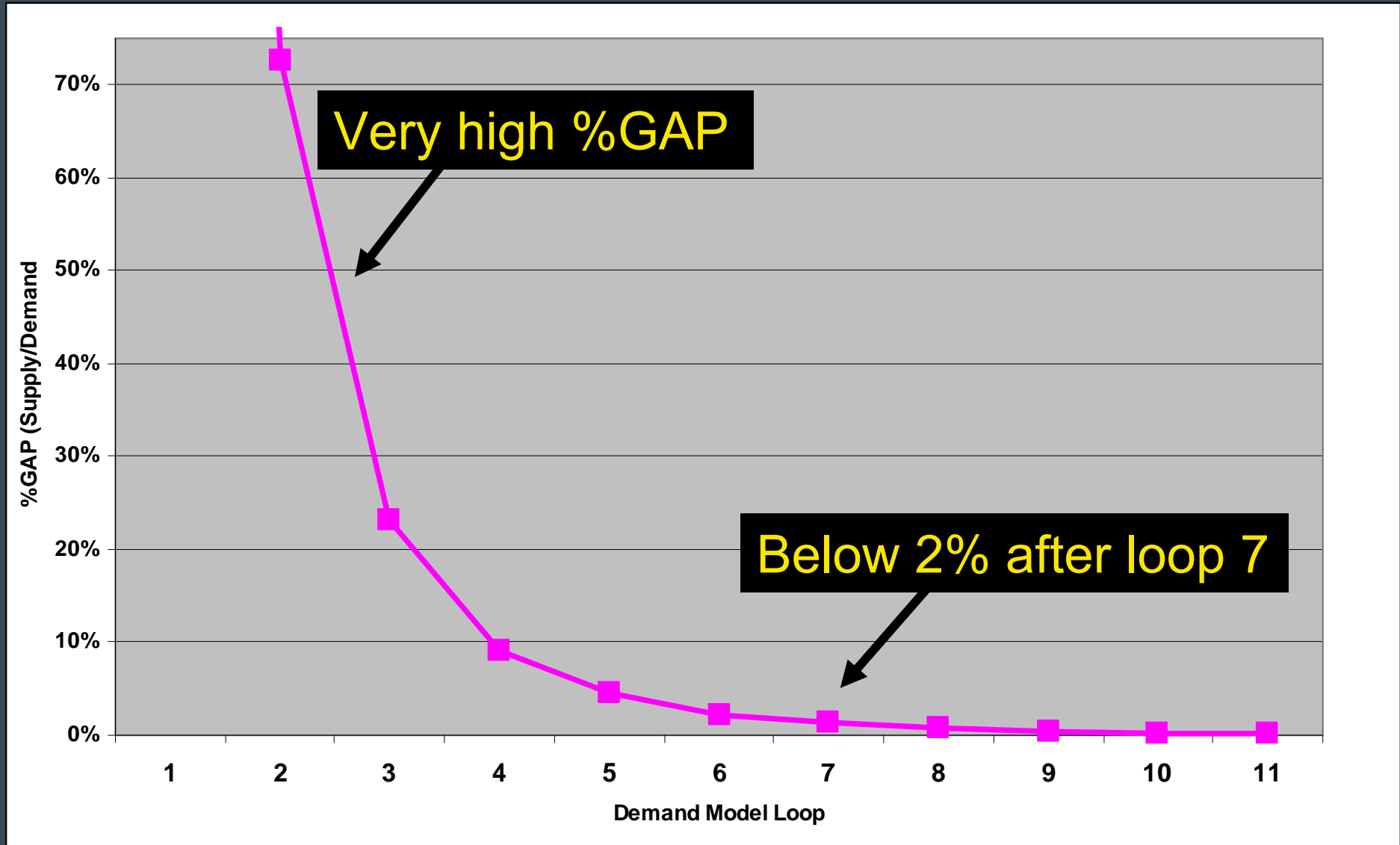
- 600 zones, 6 assignment user classes
- Target supply/demand equilibrium (%GAP) = 0.20%
- SATURN Highway Convergence (%GAP) = 0.05%
- Up to 20 demand model loops

## Runtimes:

- Standard desktop PC = 70+hrs
- Latest innovations:
  - Quad-core Xeon workstation (X5450)
  - Parallel assignments and skimming (one core per time period)
  - Simultaneous skimming (Time, Distance, Tolls) with SKIM\_ALL
- Current runtimes PC = 24hrs (SATURN = 70%)
- Further time savings required ...

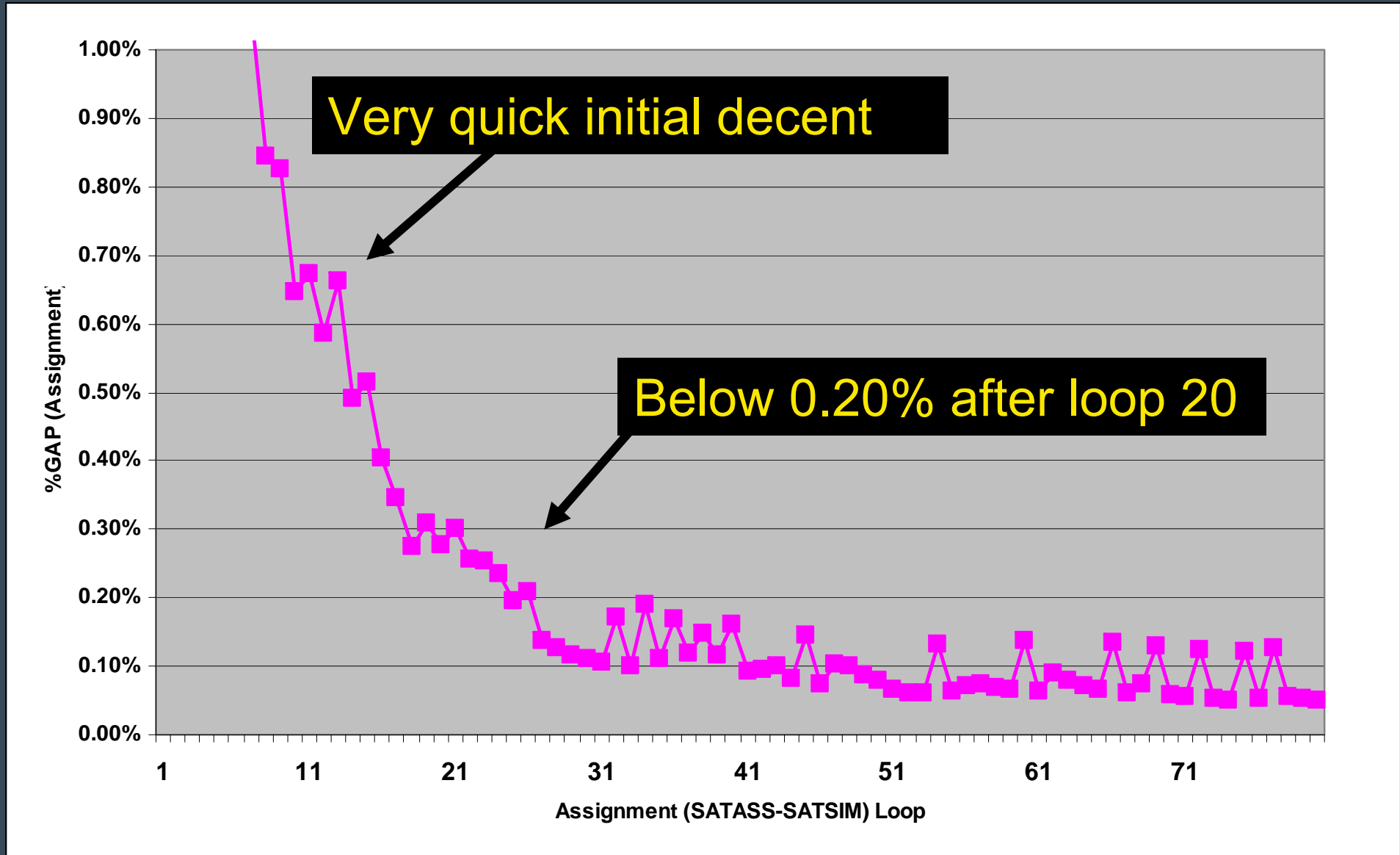
# Demand Model Convergence

Typical profile (2031 Forecast Year):



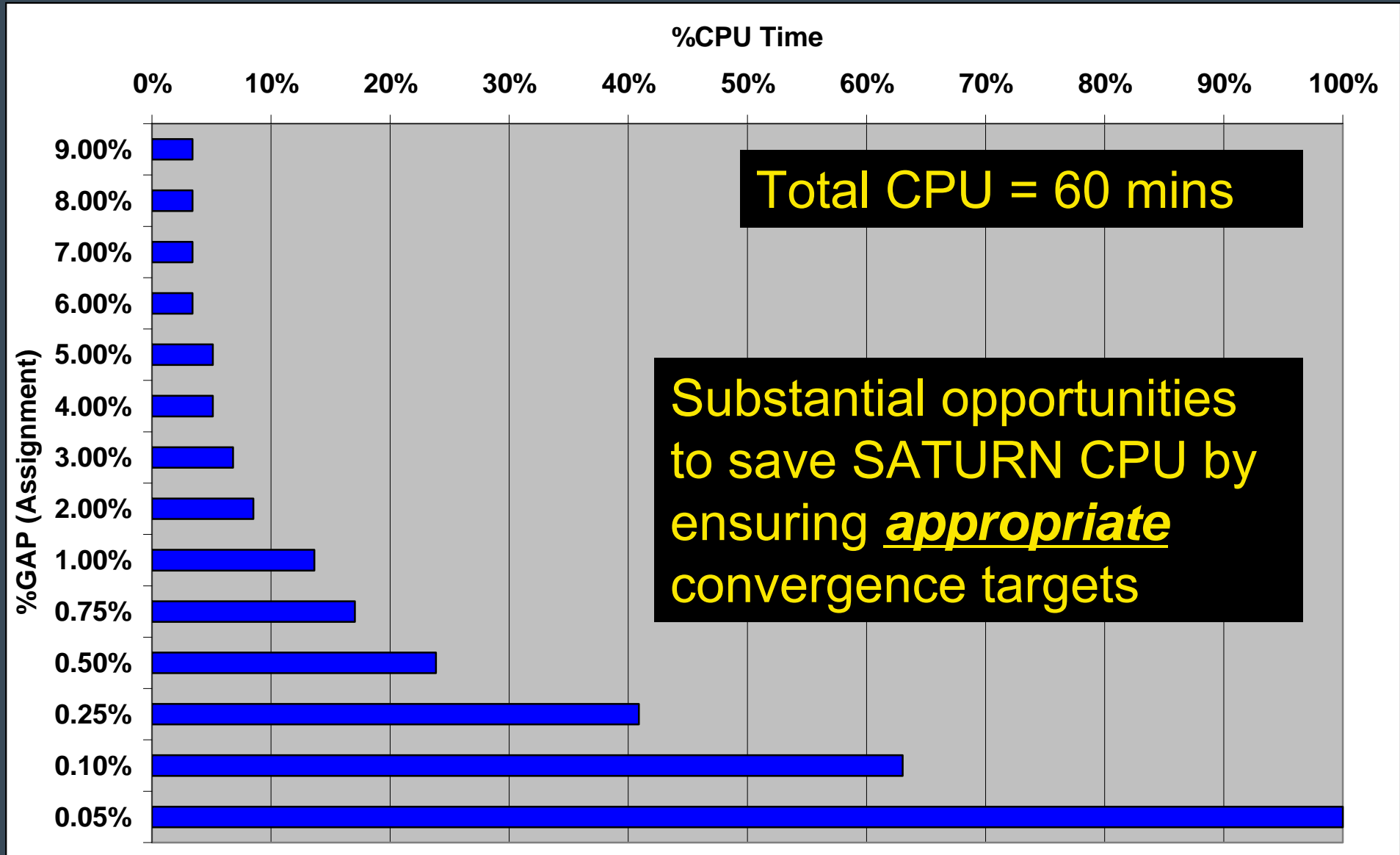
# SATURN Model Convergence (i)

Typical profile (2031 Forecast Year):



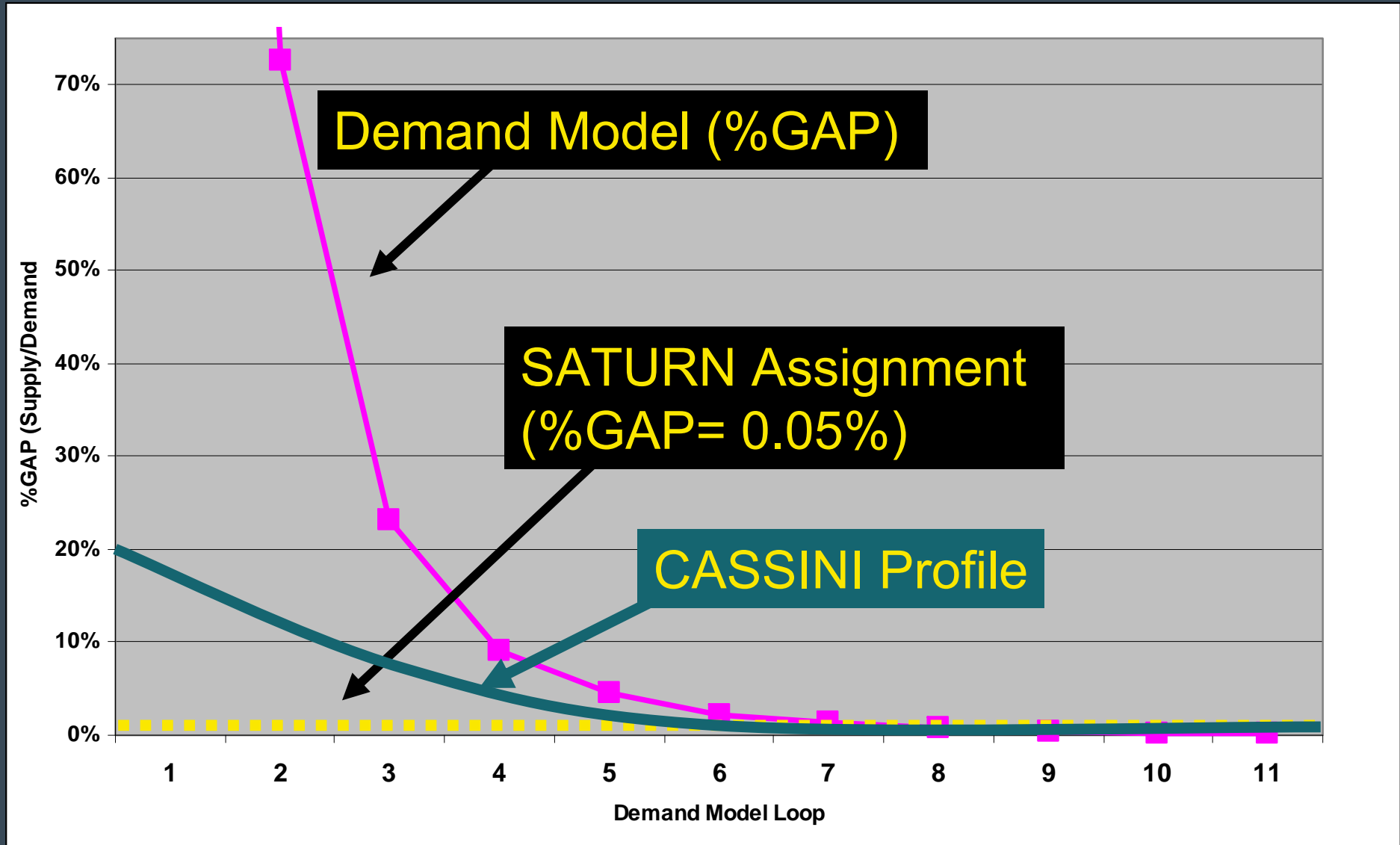
# SATURN Model Convergence (ii)

Typical profile (2031 Forecast Year):



# Comparing convergences

Typical profile (2031 Forecast Year):



# SATURN-CASSINI Process (i)

## Requirements:

- Determine convergence **strategy**
- **Strategy** defines thresholds triggering use of tighter convergence
- Convergence parameters set within each threshold
- Threshold selected triggered by %GAP obtained in demand model
- Initial judgement then 'fine-tuning'



Source: saturn.jpl.nasa.gov

# SATURN-CASSINI Process (ii)

## Process:

- Set initial SATURN Network parameters (relaxed convergence targets)
- Set-up CASSINI parameters within SATNET (see Section 15.54)
- Run Demand Model (as usual!)
- CASSINI called within SATNET **during** each assignment
- *Available in SATURN v10.9.10 onwards*

# SATURN-CASSINI Process (iii)

## CASSINI:

1. Extracts model convergence from (external) summary file
  - By default, **DIADEM .CSV file** or
  - Bespoke ASCII file (currently only 'GBMF-style')
2. Determines SATURN convergence strategy to apply
3. Produces SATURN **<network>.XCP** containing convergence parameters to **overwrite** existing settings
4. Runs inside SATNET automatically

*So what's the convergence strategy ...*

# SATURN-CASSINI Process (iv)

## Convergence Strategy

Range of Targets:

	Early	Middle	Late
<i>Demand Loop (eg)</i>	<i>1 to 5</i>	<i>6 to 10</i>	<i>10 to 15</i>
• STPGAP =	10%	2.5%	0.05%
• NISTOP =	1	1	2
• MASL =	10	20	80
• NITA_S =	25	100	250
• XFSTOP =	<i>Set to STPGAP</i>		
• UNCRSTS =	<i>Set to STPGAP</i>		

# SATURN-CASSINI Process (v)

## Input

Standard SATURN ASCII network file containing:

- **CASINI = T**                      Activate CASSINI \*\*
- **FILCAS = 'filename.txt'**      CASSINI Control file (ASCII)
- **FILGAP = 'filename.txt'**      Filename of Demand Model Convergence Summary (eg DIADEM.CSV) \*\*

## Output

- **<ntwk>.XCP**                      ASCII file containing updated parameters

*File examples to follow ...*

*\*\* = Late change*

# SATURN-CASSINI Process (vi)

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## CASSINI Control File

UltraEdit-32 - [E:\Network.XCP]

File Edit Search Project View Format Column Macro Advanced Window Help

66666

Network.XCP

## XCP File

Microsoft Excel - 4.40

File Edit View Ins

Arial 10

G3 8.0056835%

	A	B	C	D	E	F	G	H	I	J	K
1	Iteration		Step length	Max flow	c	Obj fn	Gap	Cost stability			
2	Main	Sub				Abs	Rel	RAAD	AAD	RMS	%<5%
3	1	1	0.3	0	3289.929	106751.3	8.01%	0	0	0	0%
4	2	1	0.3	-5.3062	4400.637	124263.5	8.84%	0.083895	1.1828	1.906136	50.62%
5	3	1	0.3	-10.6656	1904.122	84682.3	6.09%	0.033067	0.414765	0.759381	82.44%
6	4	1	0.3	-5.5305	824.1736	55114.65	4.02%	0.032882	0.423689	0.864608	82.90%
7	5	1	0.3	2.888983	693.2769	40291.45	2.93%	0.022827	0.306729	0.592542	89.12%
8	6	1	0.3	4.777853	328.427	31538.26	2.31%	0.015312	0.234167	0.480673	93.24%
9	7	1	0.3	-1.71161	176.5888	20178.13	1.48%	0.009991	0.143058	0.292238	97.21%

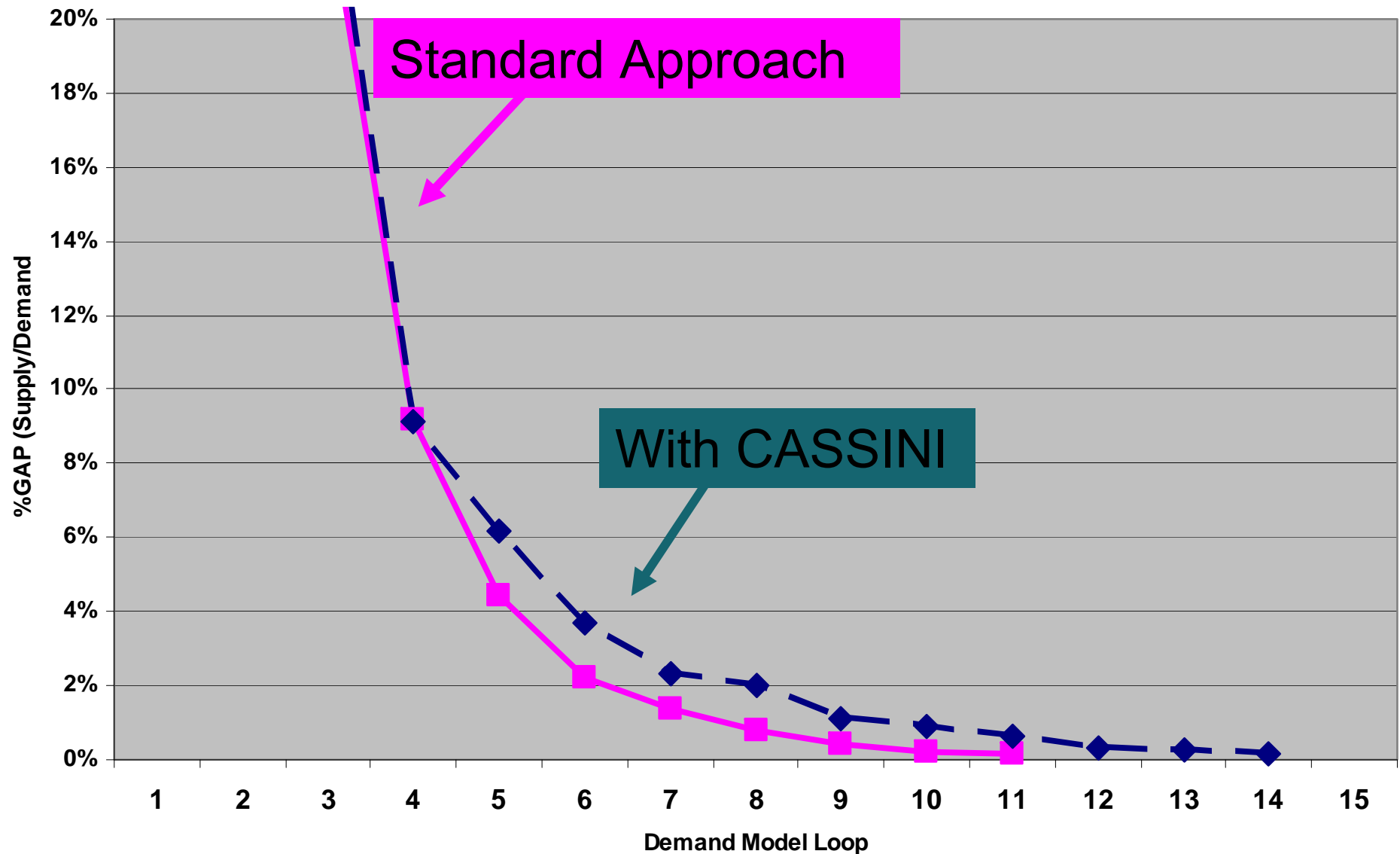
# Running SATURN-CASSINI

So what are the benefits?

- Reduced assignment time
  - Lower convergence
  - Smaller SAVEIT
- Reduced skimming time
  - Fewer paths to skim!
- Further potential for SATURN Multi-Core
  - *(already parallel assignments)*

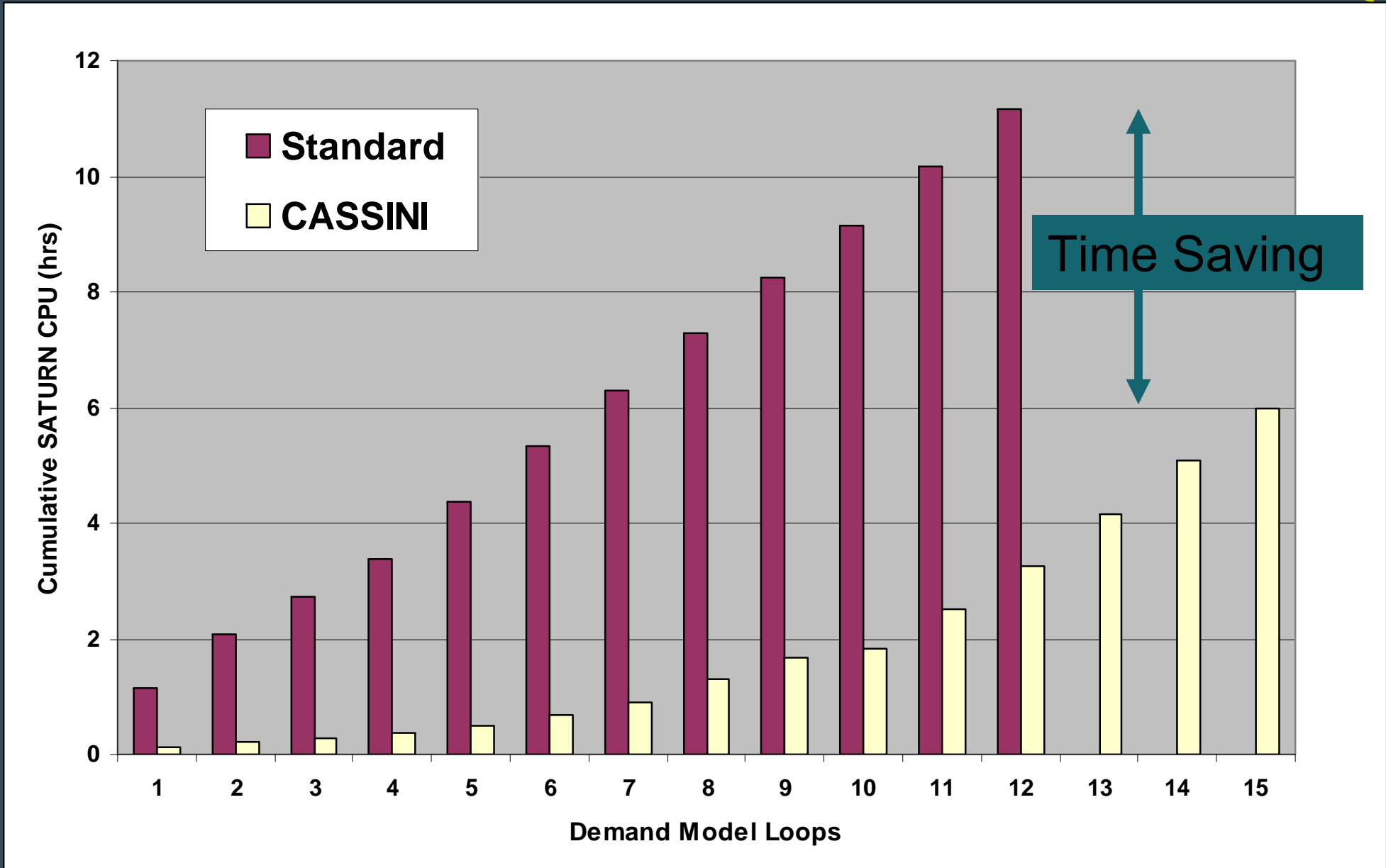
# Demand Model: GBMF With / without CASSINI

Typical profile (2031 Forecast Year):



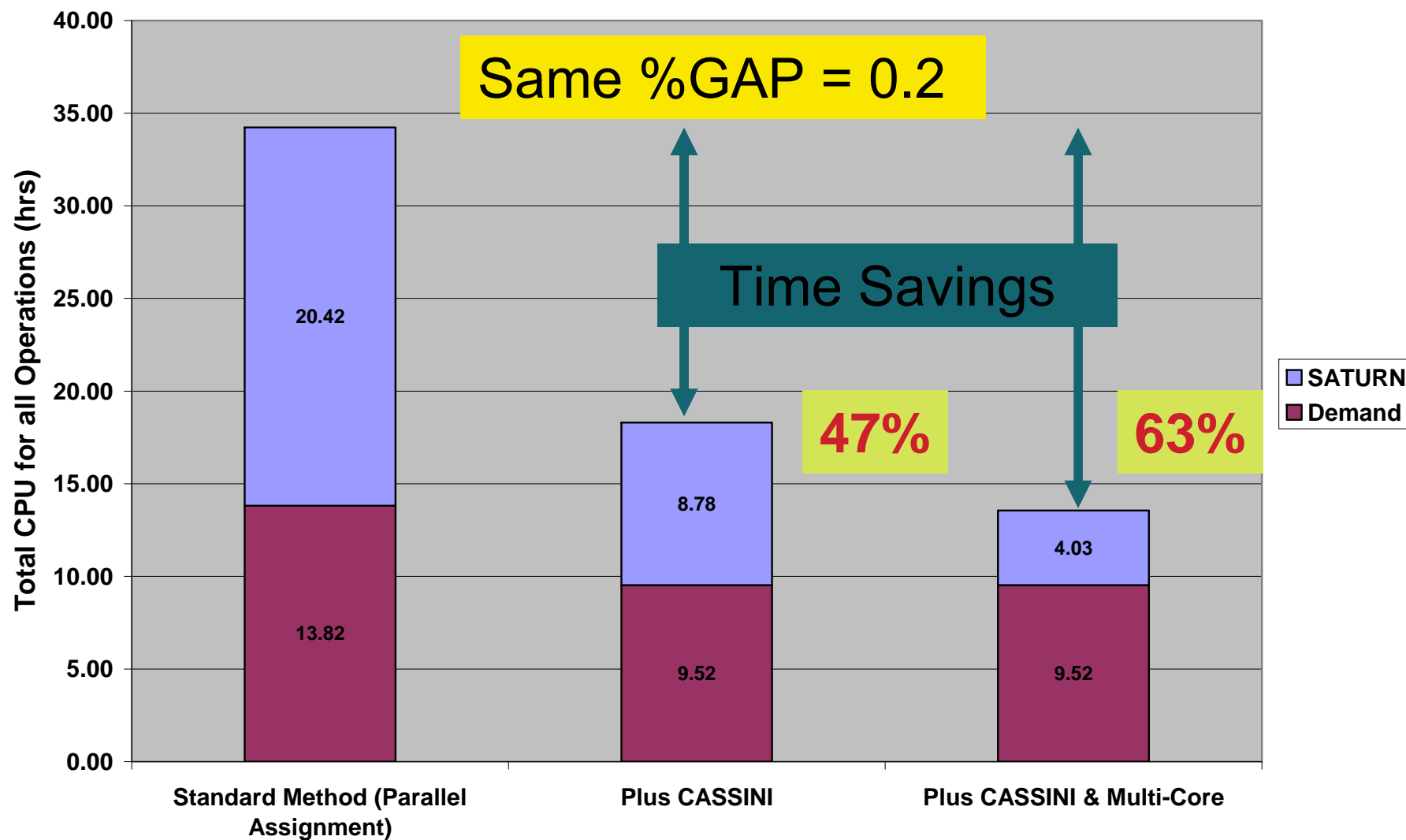
# Total Elapsed Time: GBMF With / without CASSINI

Typical profile (2031 Forecast Year):



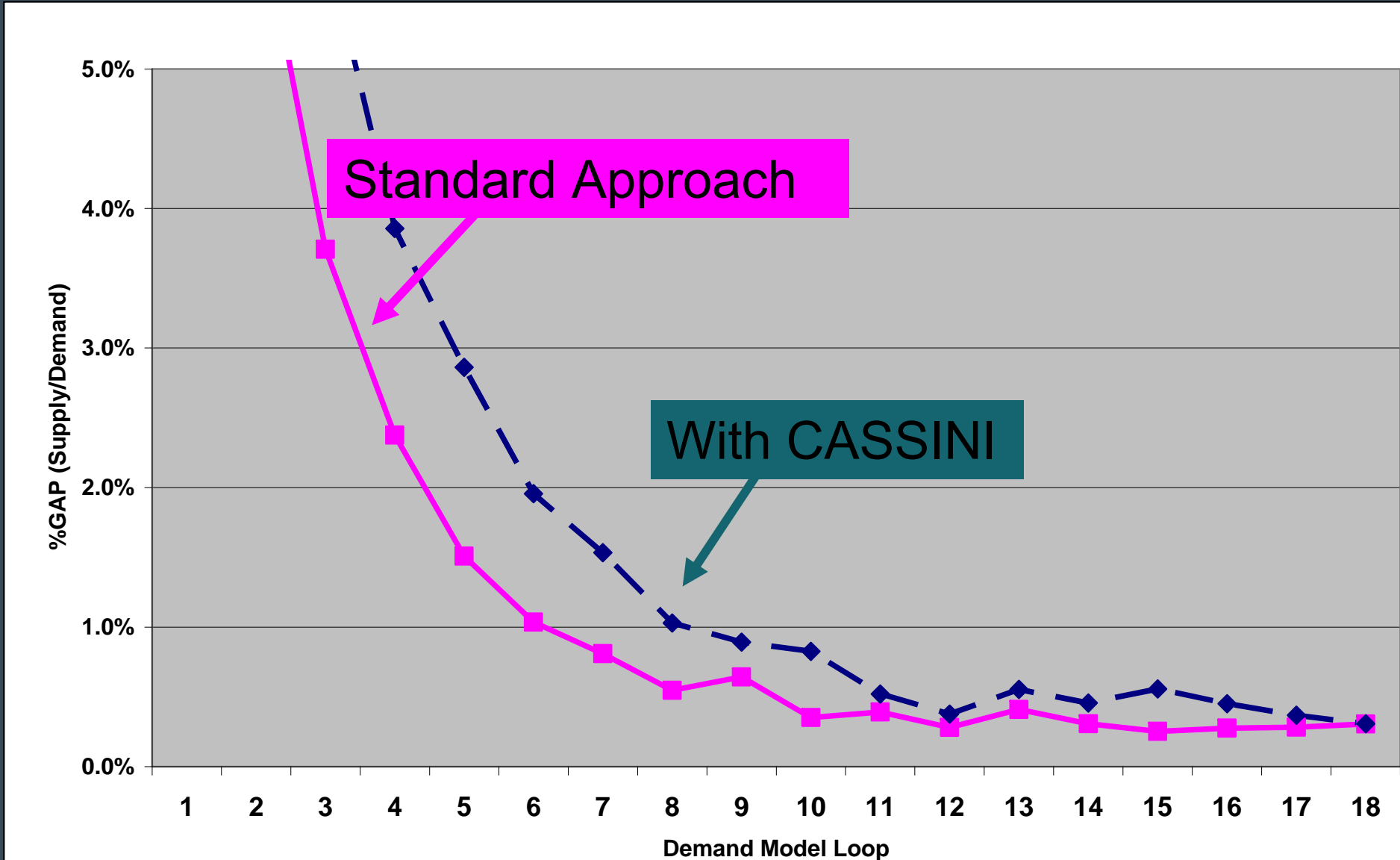
# Comparison of Runtime: GBMF

Typical profile (2031 Forecast Year):



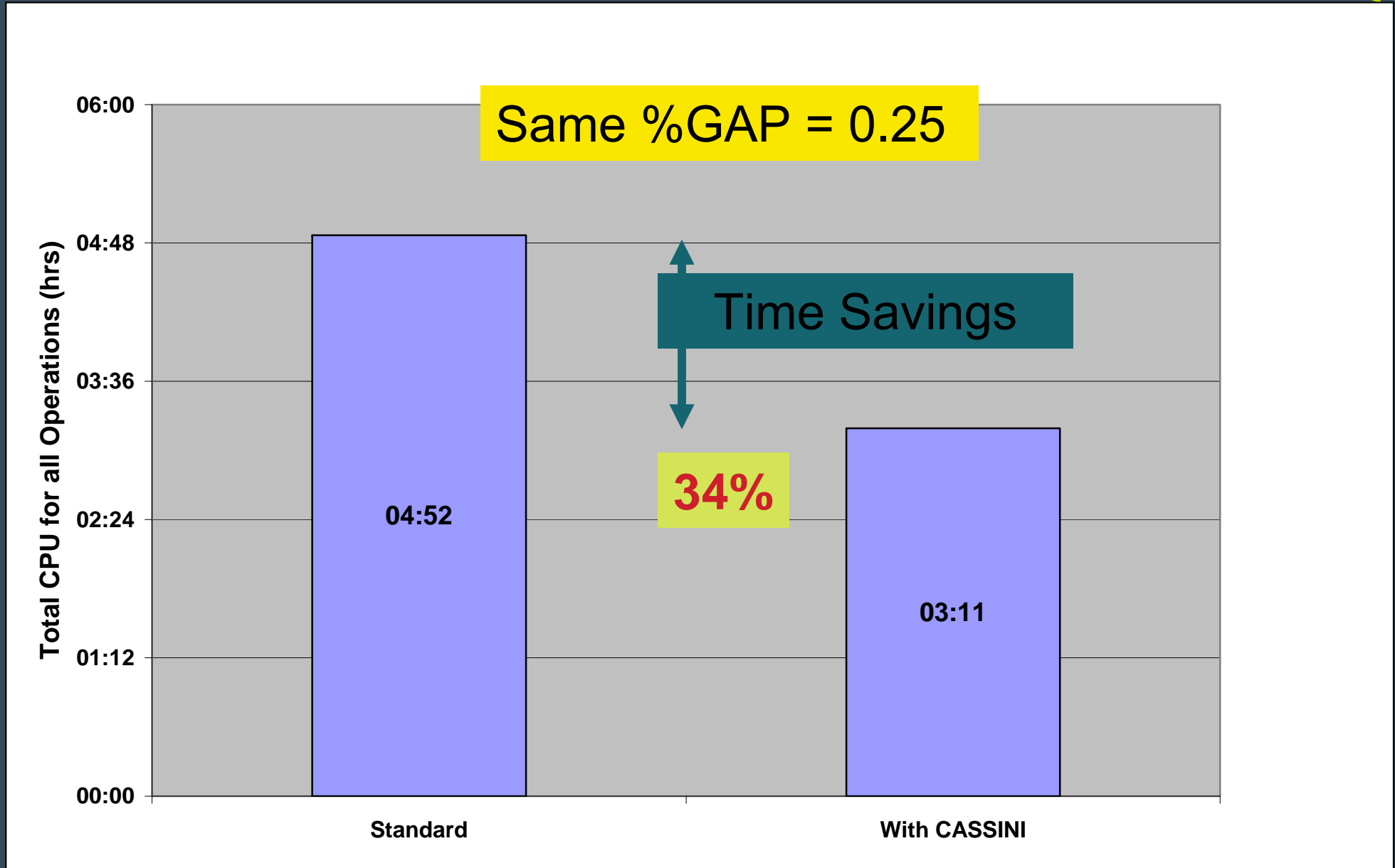
# Demand Model: DIADEM With / without CASSINI

Typical profile (2026 Forecast Year):



# Comparison of Runtime: DIADEM

Typical profile (2026 Forecast Year):



# SATURN-CASSINI Final Thoughts

## Current Status:

- Developed for GBMF
- Extended to link to DIADEM
- Works with any demand model system that reports %GAP in a text file
- Fully embedded within SATNET
- Documented in Section 15.54
- Improved file error handling
- Beta release with SATURN v10.9
- Compatible with UFC109 = T

## Next Steps:

- Test with WarmSTART and OBA MUC