

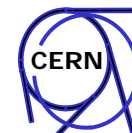


# LHC Computing Grid

## Status of Resources and Financial Plan

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24 October 2006

[www.cern.ch/lcg](http://www.cern.ch/lcg)





# Introduction

- This report presents:
  - The progress in signing the WLCG MoU
  - The common resources of LCG Phase 2 at CERN
    - Budget proposal for LCG Phase 2 at CERN in 2007
  - Resource usage accounting for external Tier-1s and CERN
  - A summary of the revised computing capacity requirements
- Details can be looked up in:
  - The written report (CERN-RRB-2006-075)
  - In the WLCG MoU (CERN-C-RRB-2005-001/Rev.)
  - The LCG planning web pages:  
<http://lcg.web.cern.ch/LCG/planning/planning.html>
    - Under: Current WLCG MoU Documents





# Signing the WLCG MoU

- 20 signatures to be collected from member states
  - For 7 Tier-1 and 22 Tier-2 centres/federations
    - Distributed over ~80 sites
- 7 of these signatures are still lacking
  - Including signatures for two Tier-1s
- 13 signatures to be collected from non-member states
  - For 4 Tier-1 and 19 Tier-2 centres/federations
    - Distributed over ~45 sites
- 3 of these signatures are still missing
- Altogether ~85% of the pledged resources are now covered by MoU signatures.
  
- The next two slides show the detailed status.





## Member States

<b>Country</b>	<b>Funding Agency/Signatory</b>	<b>Already Signed (Y/N)</b>
Belgium	FNRS	Y
Belgium	FWO	Y
Czech Rep.	MSMT CR	N
Denmark	National Science Research Council	Y
Finland	HIP	N
France	CEA/DSM/DAPNIA	Y
France	CNRS/IN2P3	Y
Germany	FZK	Y
Germany	DESY	Y
Germany	GSI	Y
Germany	MPG	Y
Italy	INFN	Y
The Netherlands	NIKHEF	Y
Norway	NRC	N
Poland	Ministry of Science & Education	N
Portugal	GRICES/LIP	Y
Spain	MEC	N
Sweden	Research Council	N
Switzerland	SER/SNF/ETH/CSCS	N
United Kingdom	PPARC	Y





### Non-Member States

<b>Country</b>	<b>Funding Agency/Signatory</b>	<b>Already Signed (Y/N)</b>
Australia	AusHEP	N
Canada	CFI	Y
China	MoST/NSFC	Y
India	DAE	Y
Japan	Univ. Tokyo	Y
JINR, Dubna	JINR	N
Pakistan	PAEC/NCP	Y
Romania	Natl. Authority for Scientific Research	Y
Russia	Federal Agency for Sc. & Innovation	N
Taipei	Academia Sinica	Y
Ukraine	National Academy of Sciences	Y
USA	US-ATLAS	Y
USA	US-CMS	Y





## Additional Tier-2 Centres

- The centres in the following table are planning to join the WLCG collaboration.
  - Signatures from Brazil and Estonia are expected soon.
- Discussions are under way with a number of additional countries/funding-agencies: WLCG will continue to grow!

<i>Institution</i>	<i>Experiments served with priority</i>			
	<i>ALICE</i>	<i>ATLAS</i>	<i>CMS</i>	<i>LHCb</i>
Austria, UIBK, Innsbruck		X		
Brazil, Brazilian Tier-2 Federation - CBPF - UERJ - UFRJ - UNESP	X	X	X	X
Canada, Canada East Tier-2 Federation		X		
Canada, Canada West Tier-2 Federation		X		
Estonia, NICPB, Tallinn			X	
Hungary, Hungarian Tier-2 Federation - KFKI, Budapest - SZTAKI, Budapest - Eotvos Univ., Budapest - Debrecen Univ.	X		X	
Israel, HEP-IL Federation - Technion, Haifa - Weizmann, Rehovot - Tel Aviv Univ.		X		
Slovenia, SiGNET Tier-2		X		





# LCG Phase 2 Budget at CERN

- The next slide shows funding and planned expenditure for Phase 2 of the LCG project at CERN in MCHF.
- Based on the revised requirement figures from the experiments the overall materials balance improved massively since the April 2006 C-RRB.
  - From -14 MCHF to -3.1 MCHF
  - The remaining shortfall is judged to be manageable.
- It should be noted that the LCG personnel planning at CERN assumes that a successor project to EGEE II delivers 14 FTE to Grid Deployment.



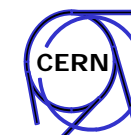


2005	2006	2007	2008	TOTAL
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<b>Funding</b>					
<b>From CERN Budget</b>	<b>2.920</b>	<b>40.335</b>	<b>34.360</b>	<b>42.325</b>	<b>119.940</b>
<b>External Contributions</b>	<b>0.000</b>	<b>3.705</b>	<b>3.070</b>	<b>1.300</b>	<b>8.075</b>
<b>Total Funding</b>	<b>2.920</b>	<b>44.040</b>	<b>37.430</b>	<b>43.625</b>	<b>128.015</b>

<b>Planned Expenditure</b>					
<b>Total Planned Expenditure</b>	<b>2.920</b>	<b>43.195</b>	<b>37.720</b>	<b>46.720</b>	<b>130.555</b>

<b>Balance Personnel</b>	<b>0.000</b>	<b>0.000</b>	<b>-0.120</b>	<b>0.655</b>	<b>0.535</b>
<b>Balance Materials</b>	<b>0.000</b>	<b>0.845</b>	<b>-0.170</b>	<b>-3.750</b>	<b>-3.075</b>
<b>Balance</b>	<b>0.000</b>	<b>0.845</b>	<b>-0.290</b>	<b>-3.095</b>	<b>-2.540</b>



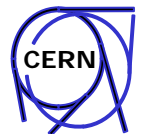




## LCG Phase 2 Materials at CERN

- The following table shows the materials expenditure for the Tier-0 and CAF in more detail.
  - Mainly to point out the investments required for Basic Infrastructure on top of CPU, disk and tape capacities for the experiments.

<b>Planned Expenditure</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>TOTAL</b>
- <i>Physics Operations</i>		4.95	4.86	4.86	<b>14.67</b>
- <i>Tier0 and CERN Analysis Facility</i>	1.41	18.40	12.20	24.20	<b>56.21</b>
- Basic Infrastructure		7.46	6.08	5.70	<b>19.24</b>
- Tier0	1.41	9.56	4.25	8.80	<b>24.02</b>
- CERN Analysis Facility		1.38	1.87	9.70	<b>12.95</b>
<b>Total Materials Expenditure</b>	<b>1.41</b>	<b>23.35</b>	<b>17.06</b>	<b>29.06</b>	<b>70.88</b>





## 2007 Budget Proposal for LCG Phase 2 at CERN

- The small negative balance for personnel in 2007 will be adjusted by re-profiling the personnel budget over the years 2007 and 2008.
- The equally small negative balance of the 2007 materials budget will be over-compensated by the positive carry-over from 2006.
- The C-RRB is therefore asked to approve the 2007 budget for LCG Phase 2 at CERN.

<b>Balance Personnel</b>	<b>0.000</b>	<b>0.000</b>	<b>-0.120</b>	<b>0.655</b>	<b>0.535</b>
<b>Balance Materials</b>	<b>0.000</b>	<b>0.845</b>	<b>-0.170</b>	<b>-3.750</b>	<b>-3.075</b>
<b>Balance</b>	<b>0.000</b>	<b>0.845</b>	<b>-0.290</b>	<b>-3.095</b>	<b>-2.540</b>





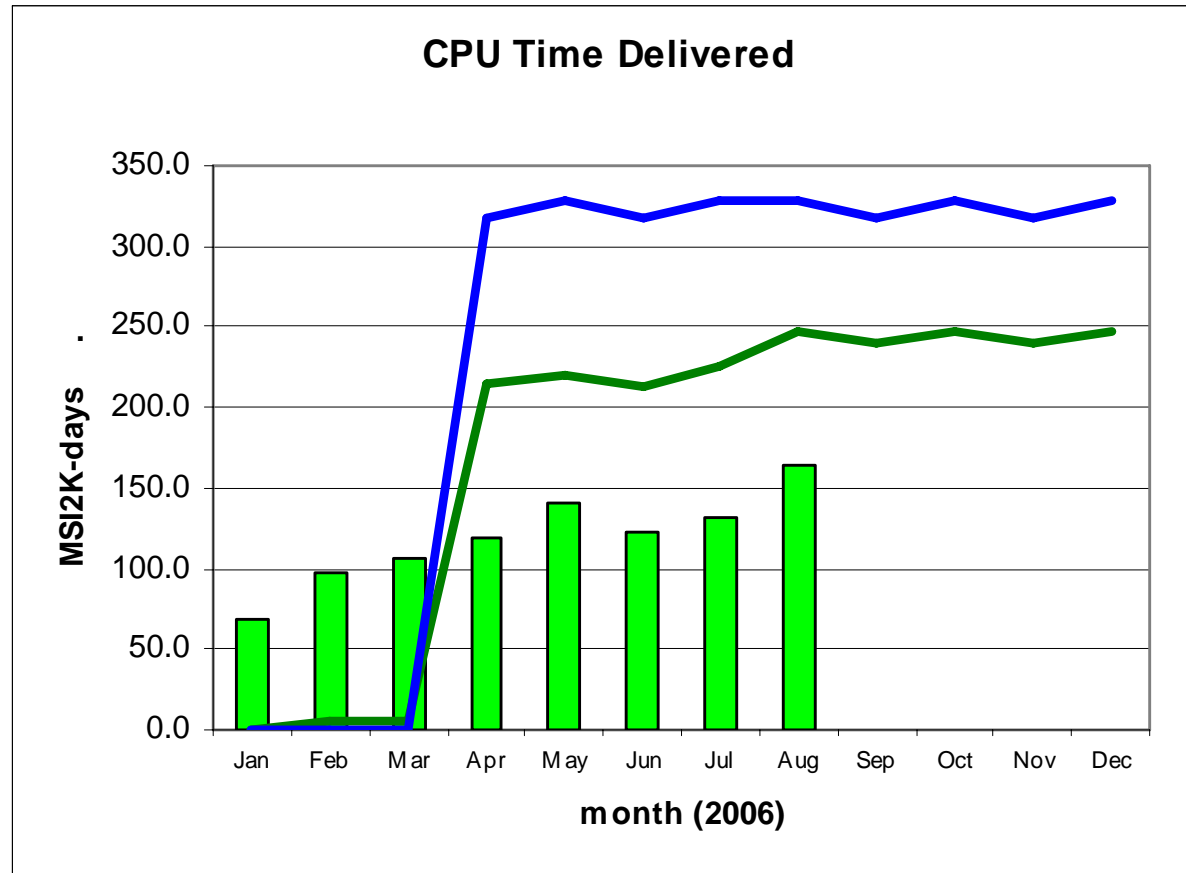
# Accounting for Tier-1s and CERN

- The graphs on the following slides show a summary of CPU Time and Disk and Tape Storage accounting from January to August 2006.
  - All sites are reporting from April onwards.
- To show the full picture of resource usage, jobs submitted via the Grid and submitted locally are both included.
- Automatic CPU time accounting exists for the EGEE sites and automatic storage accounting for the EGEE sites is being prepared.
  - Current accounting figures are based on the internal accounting systems of the sites and submitted as monthly summary tables.





# CPU Time Delivered



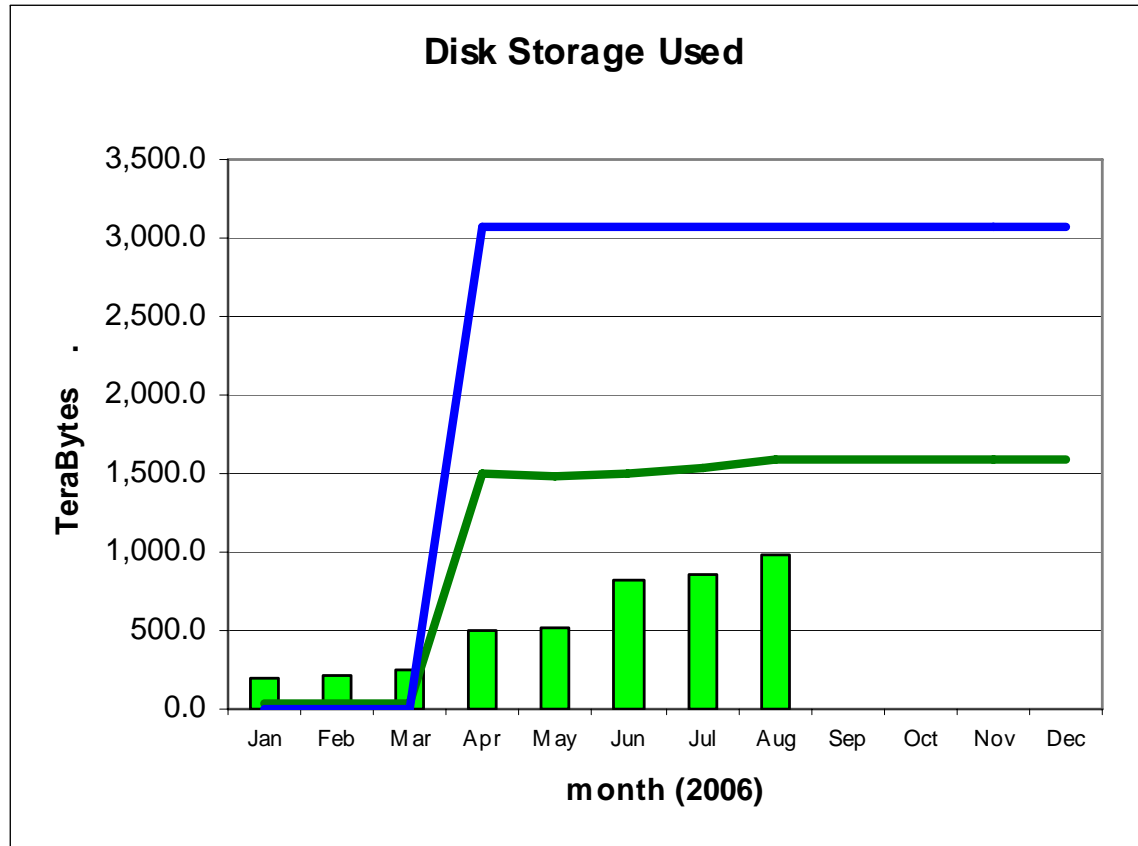
**installed capacity (inc. efficiency factor)**

**MoU commitment (inc. efficiency factor)**





# Disk Storage Used



**installed capacity (inc. efficiency factor)**

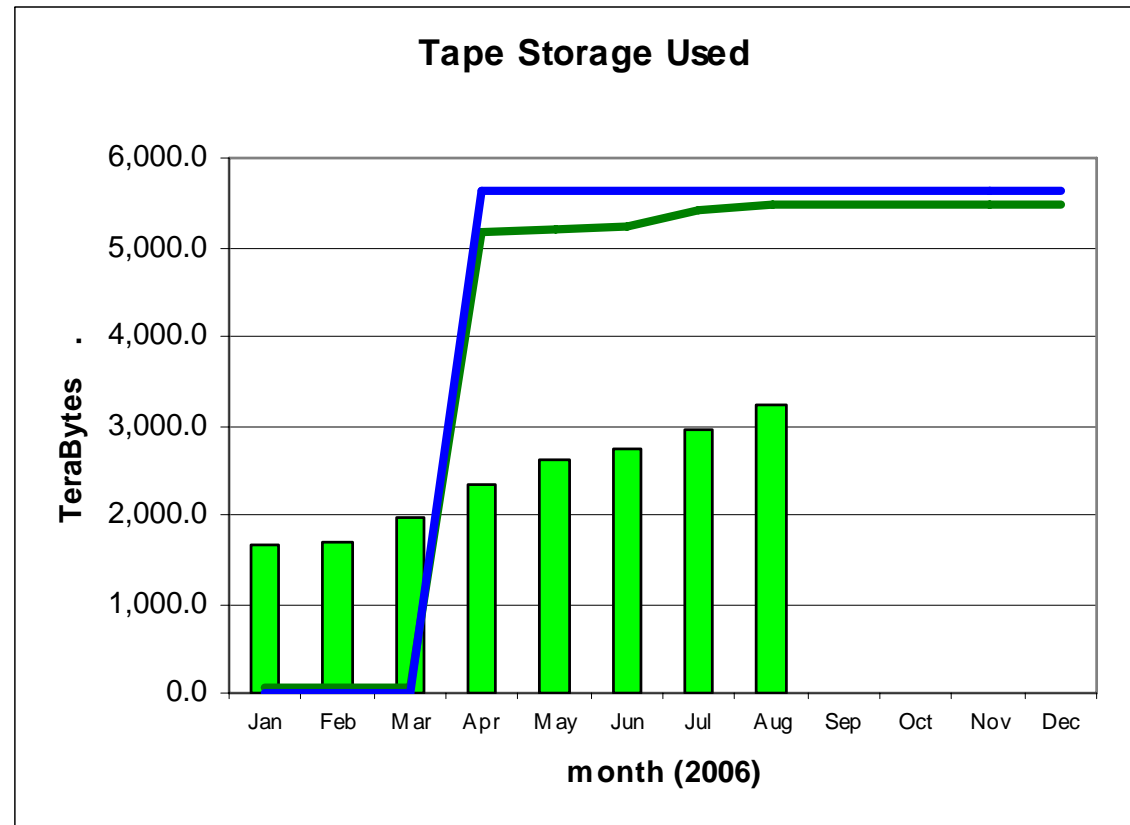


**MoU commitment (inc. efficiency factor)**





# Tape Storage Used



**installed capacity (inc. efficiency factor)**



**MoU commitment (inc. efficiency factor)**





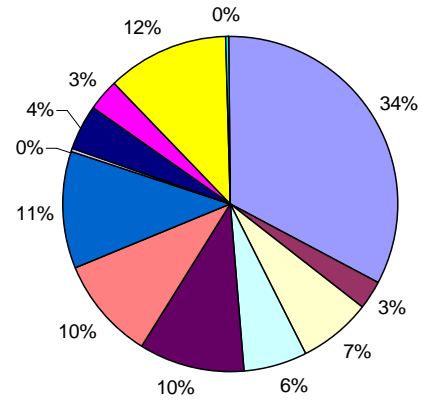
# Accounting for Tier-1s and CERN

- The graphs show an interesting difference between the rate of CPU/Disk and Tape installations.
  - Prices for tape equipment are expected to stay constant whilst purchasing CPU and Disk as late as possible will lead to savings.
- Overall usage of the resources looks low, but higher peaks are buried under the monthly averages.
  - High continuous usage cannot be expected before the arrival of the first data from the LHC.
  - Usage now is for data challenges, testing and commissioning, which require sufficient capacity for short times.
  - There is still a need to increase the installed capacity to learn handling the amount of equipment required for 2008 and onwards.
- The next graph shows usage by site.
  - A detailed table can be found in the report.

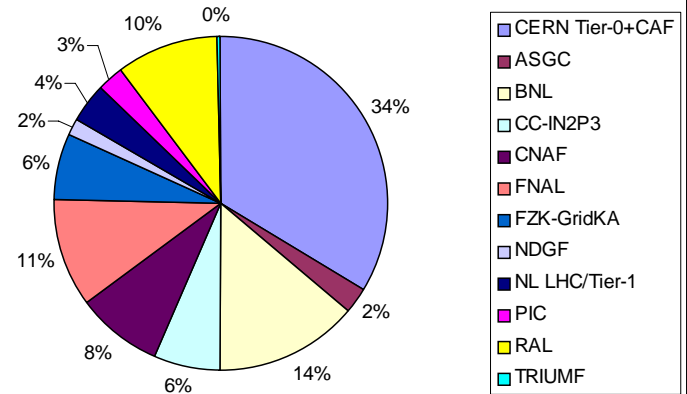




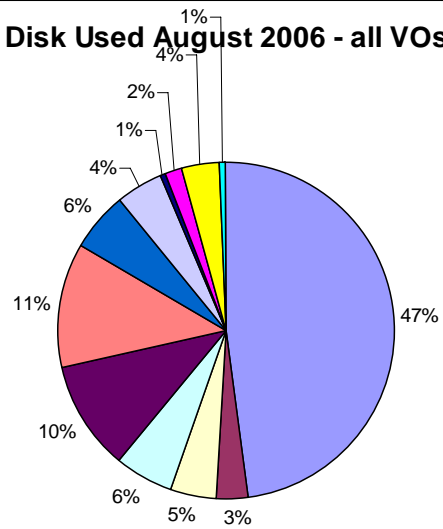
**CPU Used August 2006 - all VOs**



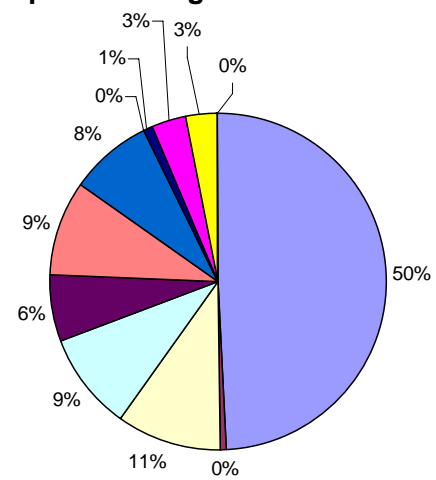
**CPU Used Jan-August 2006 - all VOs**



**Disk Used August 2006 - all VOs**



**Tape Used August 2006 - all VOs**

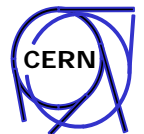






# Revised Computing Capacities

- The latest information on the start-up of the LHC produced new estimates for the data taking time in 2007 and 2008.
- Based on these figures the experiments have revised their requirements for computing capacity in 2007-2010.
  - Also taking account of latest information on event sizes, trigger rates and program performance.
- The tables on the next slides compare the total of the new requirements with the sum of the current pledges.





# Requirements and Pledges at CERN

<b>CERN Tier0 + CAF</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
<b>CPU (kSI2K) required</b>	7570	21080	28440	42790
<b>CPU (kSI2K) pledged</b>	7570	21080	28440	29700
<b>Balance</b>	0%	0%	0%	-31%
<b>Disk (Tbytes) required</b>	1290	4150	6930	12590
<b>Disk (Tbytes) pledged</b>	1290	4150	6930	8700
<b>Balance</b>	0%	0%	0%	-31%
<b>Tape (Tbytes) required</b>	2280	10690	23410	41080
<b>Tape (Tbytes) pledged</b>	2280	10690	23410	28000
<b>Balance</b>	0%	0%	0%	-32%





## Requirements and Pledges at External Tier-1s

Tier1s	2007	2008	2009	2010
<b>CPU (kSI2K) required</b>	13113	42523	68623	116143
<b>CPU (kSI2K) pledged</b>	18424	47735	70568	104944
<b>Balance</b>	40%	12%	3%	-10%
<b>Disk (Tbytes) required</b>	6277	21784	38885	66308
<b>Disk (Tbytes) pledged</b>	9069	24037	35312	53615
<b>Balance</b>	44%	10%	-9%	-19%
<b>Tape (Tbytes) required</b>	6857	28684	55500	92092
<b>Tape (Tbytes) pledged</b>	7997	23621	40267	58880
<b>Balance</b>	17%	-18%	-27%	-36%





## Requirements and Pledges at External Tier-2s

Tier2s	2007	2008	2009	2010
CPU (kSI2K) required	15926	46874	79923	128885
CPU (kSI2K) pledged	28295	48152	64316	82074
Balance	78%	3%	-20%	-36%
Disk (Tbytes) required	3543	14413	25315	40365
Disk (Tbytes) pledged	6847	12836	19261	25080
Balance	93%	-11%	-24%	-38%





## Revised Computing Capacities (2)

- The message given by these tables is clear:
- Still at the last C-RRB the total of the pledges did not cover the total requirements of the experiments.
- Now, this shortfall has been largely eliminated and we have the chance to fund the computing required for exploiting fully the potential of the LHC machine and detectors.
- But we should not forget that we are looking here at global balances. A lot of work is still required to fit the detailed requirements of all the experiments and sites to the global picture.
- Remember also that a major part of site investments is in infrastructure required to handle peak loads.
- The experiments, funding agencies and sites will have to start now intensive discussions with the view to arrive at a detailed balance of all requirements and pledges before the C-RRB of April 2007.

