

PAF Report (22/05/2006): Analysis of resources

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PAF work plan

(Closely linked to the agenda of the CERN Council Strategy Group)

[\[http://council-strategygroup.web.cern.ch/council-strategygroup/\]](http://council-strategygroup.web.cern.ch/council-strategygroup/)

- Preliminary Recommendations → CERN direction (19/12/2005)
- Plans for the LHC upgrade → Open Symposium (Orsay 30/01 – 1/02)
- Plans for ν 's and RIB's → CCSG (15/03)
- Overall strategy with priorities } → CERN direction (19/04)
and cost estimates } → CCSG workshop (Zeuthen 2/05 – 6/05)
- Detailed data } → CERN council (Lisbon July)
} → Medium Term Plan (Autumn)

Publications:

- “Preliminary accelerator plans for maximizing the integrated LHC luminosity”, [CERN-AB-2006-018-PAF](#)
- “Potential for neutrino and radioactive beam physics of the foreseen upgrades of the CERN accelerators”, [CERN-AB-2006-019-PAF](#)

List of actions (PAF recommendations)

Subject	Main contributors
Consolidation (magnets, power supplies, ...)	<u>S. Baird</u> , R. Garoby, R. Ostojic
Injectors improvements and upgrades	T. Linnecar, <u>E. Shaposhnikova</u> , M. Giovannozzi
LHC consolidation and upgrade	R. Ostojic, L. Rossi, <u>F. Ruggiero</u> , W.Scandale, L. Tavian, T. Linnecar
Linac4 & PSB issues	M. Benedikt, <u>R. Garoby</u> , M. Vretenar,
HIE ISOLDE	<u>M. Lindroos</u>
PS2	<u>M. Benedikt</u> , F. Bordry, R. Garoby, K.H. Mess
PS2 injector	O. Bruning, <u>R. Garoby</u>
PS2+ / SPS+	O. Bruning, L. Rossi, <u>W. Scandale</u>
Future v facilities	M. Benedikt, <u>R. Garoby</u> , J. Lettry, T. Linnecar, L. Rossi
New LHC dipole	<u>L. Rossi</u>

Preliminary remarks

- **Some proposed projects / upgrades may be missing because we are not aware of them.**
[e.g.: HIE ISOLDE which has been inserted at the last minute].
- **Only items not already funded in the MTP are considered.**
[e.g.: for consolidation, only expenditures beyond the already allocated amount (50 MCHF until 2008) are counted].
- **For construction projects (Linac4, PS2 etc.), all resources are supposed to come from the CERN budget.**
[in-kind contributions from outside will reduce the resources needed at CERN].
- **For R & D activities, the amount given is the CERN part in a presently assumed international work programme.**
[resources from FP7 can reduce the CERN effort, LARP R & D is supposed to continue...].
- **The fraction of the resources which are available has not been determined.** *It strongly depends upon the total work programme and arbitration between priorities.*

Collected data (1/2)

- **Consolidation:**
 - based on the programme managed by S. Baird
 - includes necessary additional actions not yet started (PS access system, ...)
 - includes consolidation of the AD (not analysed by POFPA for the time-being).
- **Linac4 & PSB:** construction of Linac4 and modification of the PSB
- **PS2:** design and construction of a normal conducting successor of the PS (50 GeV / 1.2 km).
- **Other injectors improvements - distinction between 3 stages:**
 - Basic improvements to maximize reliability (reduce “turn around time”) beyond nominal beam characteristics in LHC (longitudinal dampers in all machines, PS new multi-turn ejection, etc.)
 - R & D to prepare for ultimate luminosity and beyond (high power RF devices, 160 MHz/240 MHz tunable RF system for acceleration in SPS)
 - Implementation of upgrade for ultimate luminosity and up to $10^{35}\text{cm}^{-2}\text{s}^{-1}$ (12.5 ns bunch spacing with new RF system at 160/240 MHz in SPS).

Collected data (2/2)

- **LHC consolidation and upgrade – distinction between 3 stages:**
 - Basic improvements to reliably operate up to and beyond nominal luminosity in the LHC (dilution kickers, study and implementation of a full performance collimation system, new NbTi quads for insertions.)
 - R & D to prepare for ultimate luminosity and beyond (R & D for 1.2 GHz and 160 MHz/240 MHz RF systems, prototyping of cryo system upgrade, R & D on Nb₃Sn quads for future IRs)
 - Implementation of upgrade for ultimate luminosity and up to $10^{35}\text{cm}^{-2}\text{s}^{-1}$ (12.5 ns bunch spacing, bunch shortening with 1.2 GHz RF, $\beta^* = 0.25$ m with Nb₃Sn quads, ...)
- **PS2+ / SPS+:** R & D for fast cycling superconducting magnet (synergy with the needs of FAIR)
- **HIE ISOLDE:** Preliminary data
- **Future ν facility:**
 - R & D for a future ν facility (mostly oriented towards ν factory),
 - Includes sc magnets for μ and H⁺ storage rings, RF power devices and sc cavity development for μ acceleration, target and target areas, beam dynamics studies.
- **New LHC dipole:** R & D towards 20 – 25 Tesla dipoles...

Recommended actions

Priority 1

Consolidation [Basic consolidation of all accelerators]

Basic injectors improvements [Feedbacks in PS & SPS, new power supply for SPS...]

LHC basic consolidation [dilution kickers, collimators, new NbTi quads...]

PS2 design [design and simulations]

PS2 injector conceptual design [design and simulations, H- source development]

Priority 2

Linac4 construction

R & D for injectors improvements (towards $10^{35} \text{ cm}^{-2}\text{s}^{-1}$) [tunable 160/240 MHz RF system for SPS, high power RF items...]

R & D for LHC upgrade (towards $10^{35} \text{ cm}^{-2}\text{s}^{-1}$) [1.2 GHz and 160/240 MHz RF systems, Nb3Sn quads...]

Priority 3

ν factory R & D

R & D for PS2+ and SPS+ [fast cycling sc magnets]

R & D for new LHC dipoles

To be considered in 2010-2012

PS2 construction

Upgrade to ultimate luminosity and beyond (up to $\sim 10^{35} \text{ cm}^{-2}\text{s}^{-1}$) in LHC [1.2 GHz and 160/240 MHz RF systems, Nb3Sn quads...]

To be considered in 2014-2016

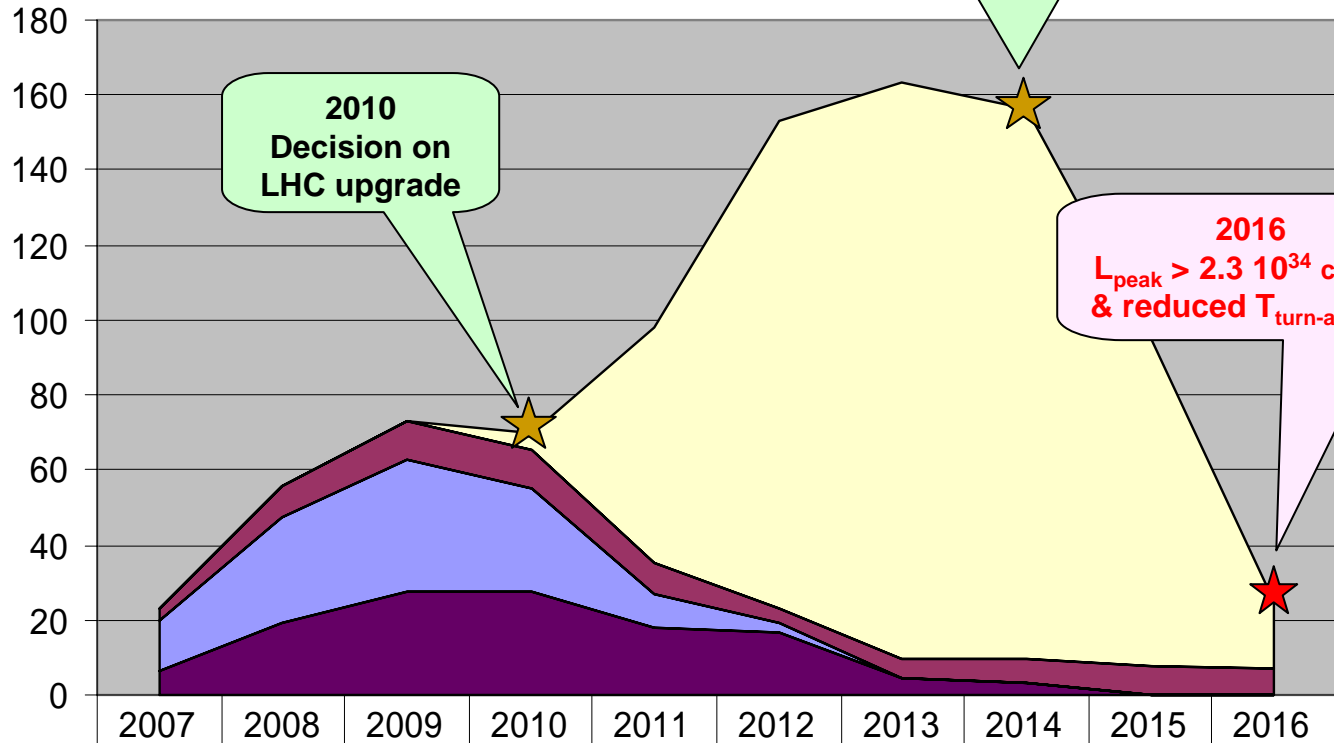
Construction of PS2 injector

Construction of ν facility

Construction of SPS+

Material resources

Material (MCHF)



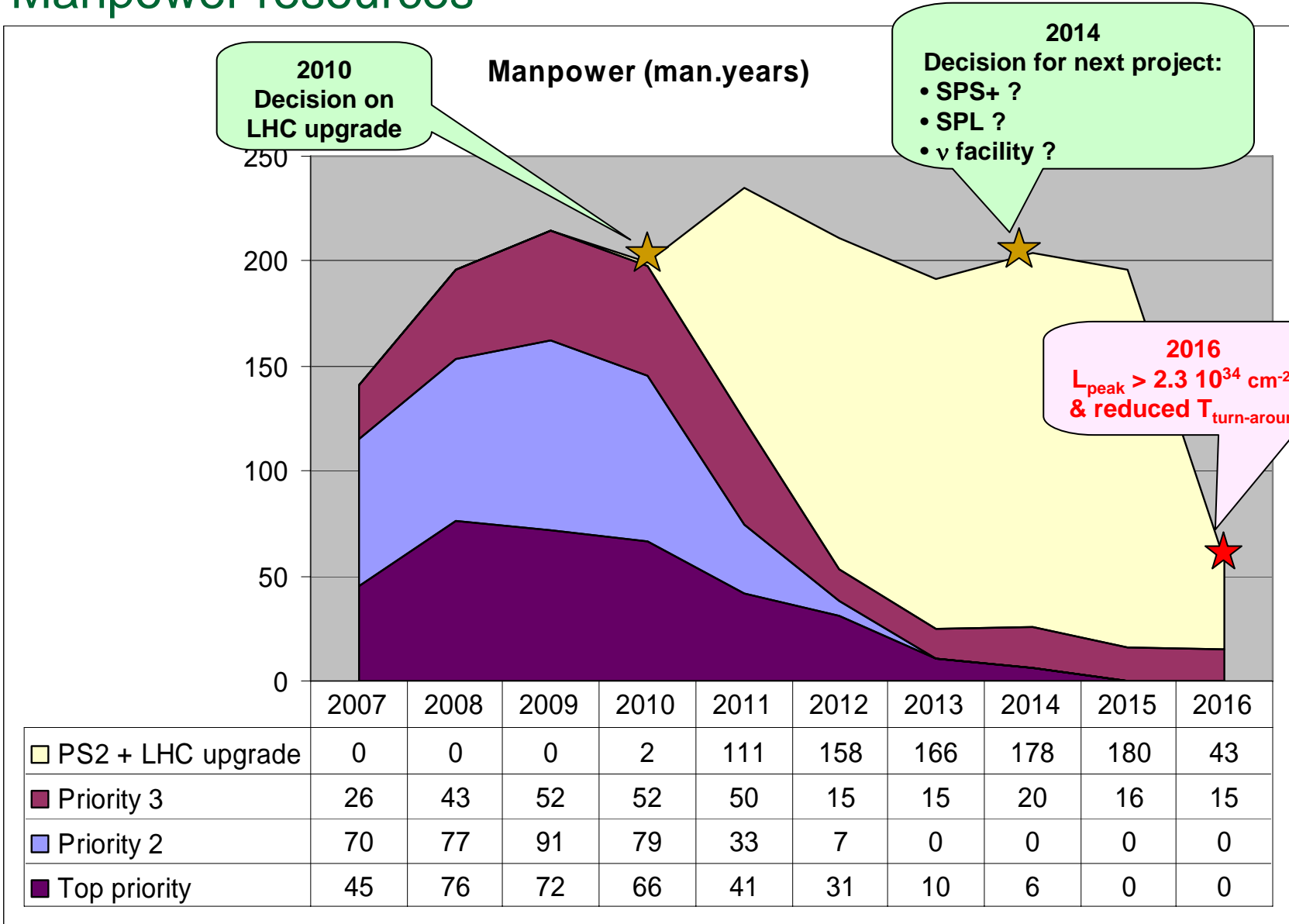
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
PS2 + LHC upgrade	0	0	0	5	63	130	154	147	87	18
Priority 3	3	8	10	10	8	4	5	6	8	7
Priority 2	13	28	36	28	9	3	0	0	0	0
Top priority	6	19	27	28	18	16	5	4	0	0

2014
Decision for next project:
• SPS+ ?
• SPL ?
• ν facility ?

2010
Decision on
LHC upgrade

2016
 $L_{\text{peak}} > 2.3 \cdot 10^{34} \text{ cm}^{-2}\text{s}^{-1}$
& reduced $T_{\text{turn-around}}$

Manpower resources



Summary

This analysis has to be refined using experience with the existing machines. The results of machine and particle physics experiments can perfectly re-arrange the priorities. In any case, the following conclusions are likely to remain valid:

- Besides the resources needed to operate the existing accelerators, keeping the CERN complex competitive requires > 200 FTEs and 150 – 200 MCHF every year.
- In the period 2007-2010, a progressive increase in resources (up to 80 MCHF/year and 210 FTEs/year) is sufficient to fulfill the needs.
- The absolute minimum during this period is 30 MCHF/year and 70 FTEs/year.
- The infrastructure of the Meyrin site will have to be rebuilt during the next decade to accommodate extensive modifications / reconstructions of the low energy accelerators.

Conclusion

- Past achievements
 - Preliminary scenarios have been sketched for a logical evolution of the proton accelerator complex.
 - Preferred schemes have been chosen to allow for estimating cost and the necessary level of resources in the next five years.

- Next actions, taking into account the outcome of the CCSG meeting in Zeuthen:
 - Reconsider choices (CCSG's priorities, new technical/scientific input,...)
 - Refine the analysis (MDs, simulations, ...)
 - Refine cost estimates