



# ILC TDR Cost Methodology

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# Outline

- **Definition, Goals, Scope**
- **Value Estimating Methodology**
- **ILCU definition using Purchasing Power Parity**
- **RDR Value estimate escalated to 2012**



# Definition and goals of the estimate

- The ILC TDR cost estimate is a comprehensive, and well-documented estimate of the resources required to build the ILC, as described in the Technical Design Report.
- The ILC project is envisioned to be funded mainly by in-kind contributions from several participating nations in various regions of the world. The cost estimate should
  - allow funding agencies in nations which are considering in-kind contributions to the ILC project to assess the nature and scope of resources needed for the project, and
  - to provide detailed information on cost drivers and cost tradeoffs which can be used for further optimization of the project through value engineering and R&D.



## Scope of the estimate

- The cost estimate covers only the construction cost for the 500 GeV accelerator systems as detailed in the TDR.
- Detectors are not included, although detector assembly buildings, underground experimental halls, and detector access shafts are included.
- Costs for project engineering and design, and for R&D, prior to construction authorization, are not included.
- Commissioning, pre-operation, operation, and de-commissioning are not included.
- Taxes, contingency, and escalation during project construction are not included.
- Costs for upgrading the machine to 1 TeV are not included, except the cost of those systems which would be very difficult to provide after construction of the 500 GeV machine (e.g., beam dumps, BDS length).



# Value Estimating Methodology (1)

- In order to achieve the first goal stated on the 3<sup>rd</sup> slide, *the ILC TDR cost estimate must be structured so that it can be useful to all potential collaborators*, with different currencies and different traditions and conventions for planning and estimating the cost of large projects.
- This requires a project estimate that is independent of any particular accounting system but compatible with all of them. This is the “Value estimating methodology” used by ITER and by the LHC experiments, among others.
- The “Value estimate” has two parts: Value (expressed in currency units), and Labor (expressed in person-hours).



## Value Estimating Methodology (2)

- The **Value** of a component is defined as the lowest reasonable estimate of the procurement cost of an item with the required specification, and in the appropriate quantity, based on production costs in a major industrial nation.
  - This cost includes the cost of materials and labor at the vendor required to fabricate the item. It is effectively the barest cost estimate that would be used by any of the funding agencies.
  - An example of a Value cost element is the cost of the superconducting cavities.
- The **Labor** associated with a component or activity is defined as “explicit” labor, which may be provided by the collaborating laboratories and institutions, or may be purchased from industrial firms.
  - An example a Labor cost element is the person-hours required to install the components in the machine.



## Value Estimating Methodology (3)

- The ILC TDR cost estimate, stated in terms of Value and Labor, is the basis on which contributions may be apportioned among the collaborators. Each participant makes an agreement with the ILC project management to provide a certain amount of Value and Labor to the project, in the form of in-kind component and service contributions.
- The collaborators are then responsible for providing the contracted items, independently of what they may cost as measured by national accounting systems.
- One of the key elements of the Value estimating methodology is the definition of a common currency unit (the “ILCU”), and the development of consistent and reasonable procedures for converting costs in national currencies into this unit.



## Definition of the ILCU for the TDR

- For the 2007 RDR, the relationship between the ILCU and national currencies was based on exchange rates (averaged over the 5 years prior to 2007).
- A similar procedure in 2012 for the TDR estimate is problematic, however. This is because, in general, and particularly in times of wide fluctuations in monetary supplies related to financial crises, exchange rates do not necessarily represent true comparative prices between items manufactured in different regions of the world.
- Exchange rates can be strongly influenced by the supply and demand for different currencies, and the supply and demand for currencies are influenced by factors such as capital flows between countries and currency speculation, rather than by the needs of international trade.
- International economists have introduced the concept of “purchasing power parity” (PPP) to deal with this issue. Compiled through extensive surveys by the research arm of the Organization for Economic Co-operation and Development (OECD) and Eurostat (the European Union's statistical agency), PPP indices are price relatives derived from the ratio of the prices in national currencies of the same good or service in different countries.



# Motivations for the use of PPP indices

- **Development of the estimate.** In the development of an estimate of an item's Value, it is common to have cost estimates for the same component, from different regions, stated in different currencies. The only equitable way to compare these costs, so as to arrive at the lowest reasonable cost (the Value of the item), is on the basis of PPP indices, which are specifically designed to compare prices of similar items across national boundaries, avoiding the distortions associated with the use of exchange rates.
- **Use of the estimate by potential project partners.** The Value of each project item will be stated in terms of an ILCU based on PPP indices. Regional collaborators, seeking to assess the local resource requirements for their in-kind contributions, can use the PPP indices to translate components of the Value estimate into a true estimate of the local currency required to build those components in their region. This can be done in a way which is not dependent on volatile exchange rates, now or in the future.



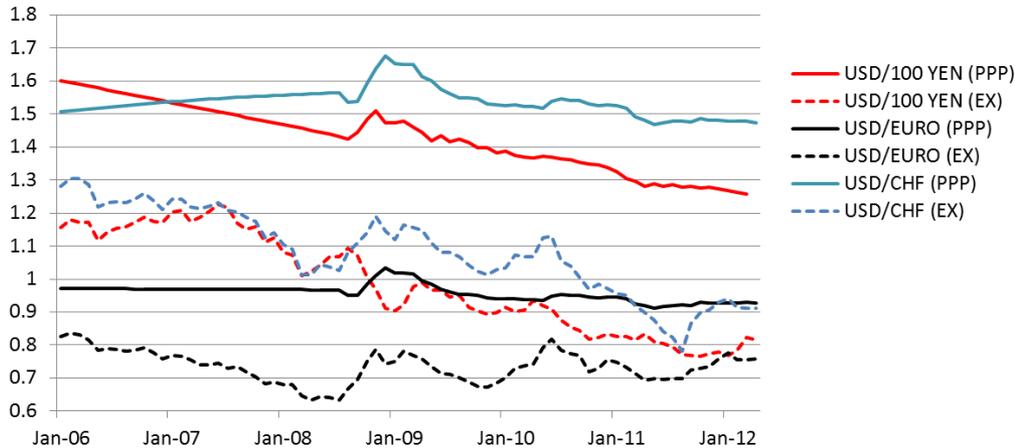
# Issues with the use of PPP

- **Complexity: need to incorporate cost element type dependence**
  - Just like inflation indices, PPP indices depend on the type of item (consumer goods, food, manufactured items, etc).
  - The Eurostat-OECD price surveys have derived and published item-specific PPP indices. The two item types relevant to the TDR cost estimate are civil engineering (“construction”) and manufactured items (“machinery and equipment”)
- **Accuracy**
  - Eurostat-OECD price surveys are comprehensive and well-documented. For industrialized nations, estimates of the standard errors for PPP indices are in the range of 5-8%.
  - These uncertainties are typically smaller than the uncertainties in the local currency estimates themselves, and are certainly smaller than the price distortions resulting from the use of exchange rates,
- **Extrapolation: need to extrapolate from 2008 survey**
  - The most recent PPP benchmark survey was in 2008, and the results from the next one, to be made in 2011, will not be available until 2013.
  - Following OECD recommended practice, the current PPP index can be obtained by extrapolation from the 2008 PPP index, based on the relative national rates of inflation from 2008 to the present, for the two national currencies which are related by the index.
  - Errors introduced by this extrapolation are expected to be ~5%.
  - If required, once the 2011 Eurostat-OECD PPP benchmarks become available, the cost estimate could easily be updated.

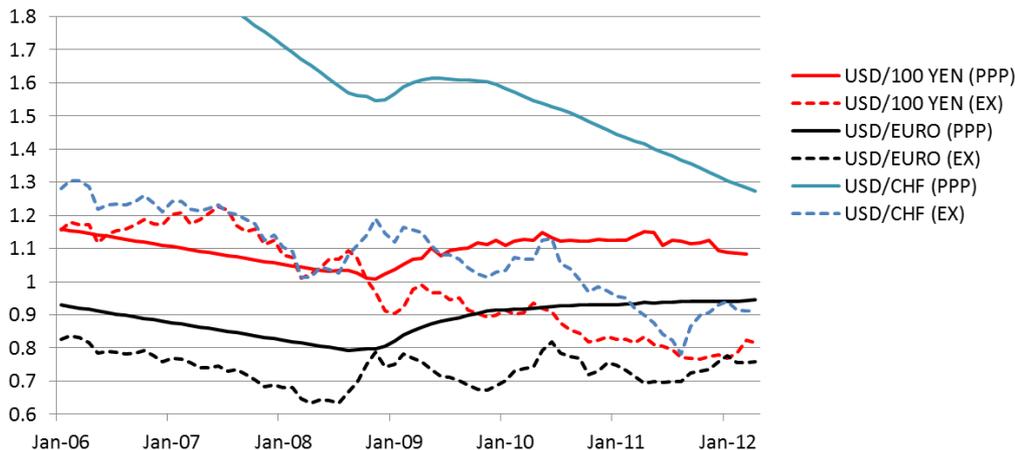


## Definition of the ILCU for the TDR

Exchange rates and purchasing power parity (machinery and equipment) indices for Euro, Yen and Swiss Franc relative to USD, since 2006



Exchange rates and purchasing power parity (civil construction) indices for Euro, Yen and Swiss Franc relative to USD, since 2006



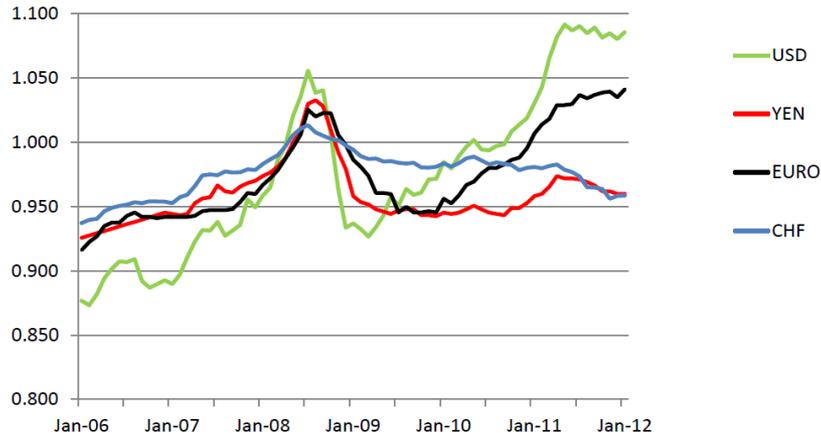
The TDR cost estimate will be stated in 2012 ILCU, defined as USD of Jan 1, 2012, and related to other currencies using purchasing power parity (PPP) conversions to USD as of that date. (For superconducting material only, which is a commodity with only a few sources, exchange rates are used.)

- Construction: civil engineering work only
- Machinery and equipment: everything else

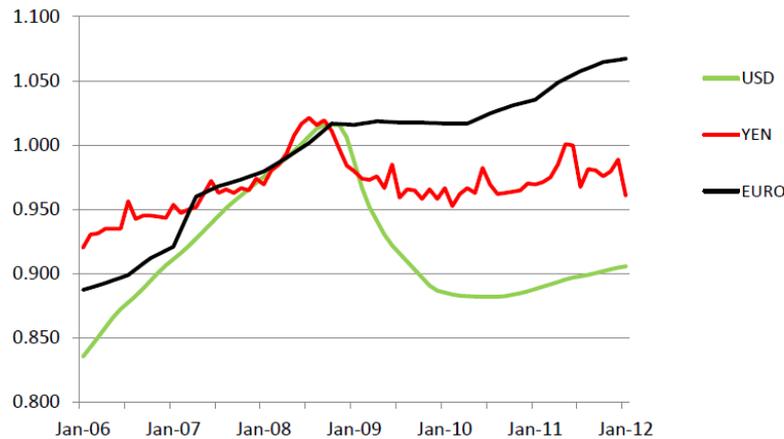


# Escalation and re-statement of the ILC-RDR cost estimate

Machinery and Equipment inflation indices for Euro, Yen, Swiss Franc, and USD



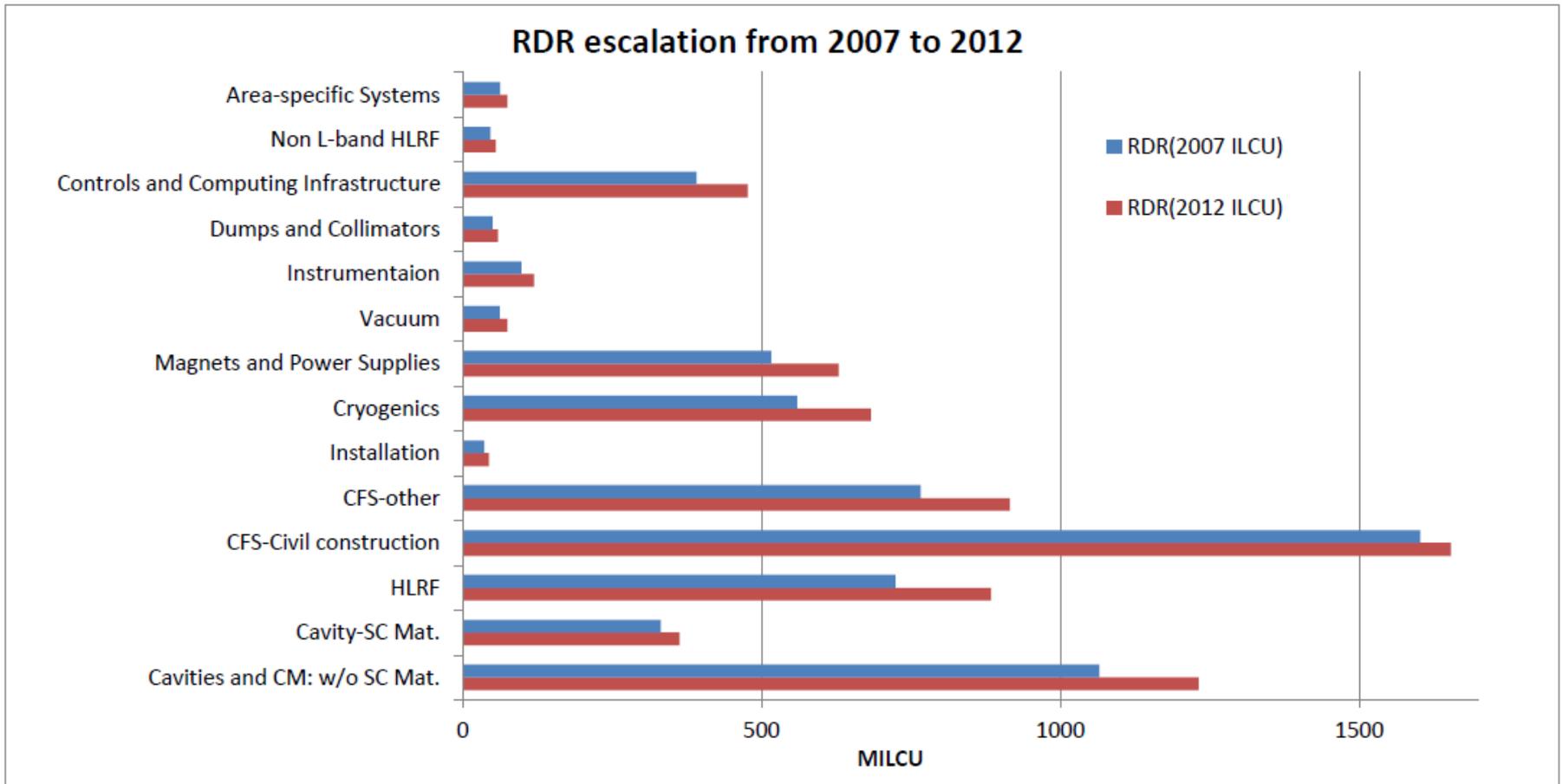
Civil engineering inflation indices for Euro, Yen, and USD



- With this definition of the ILCU for the TDR, the RDR cost estimate can be re-stated in these units by
  - escalating the elements of the RDR cost estimate (stated in the original currencies in which the estimates were made) from 2007 to 2012, based the regional escalation shown to the left, and
  - converting to 2012 ILCU using the PPP indices shown in the previous slide.
- The result would be the TDR estimate if the TDR design and cost basis were the same as the RDR. In fact, the TDR design is different, and only 25% of the RDR cost basis will be used for the TDR.



# ILC RDR estimate, escalated to 2012



Total ILC RDR estimate: 7268 MILCU (2012).  
6312 MILCU (2007).

Average escalation: 15%



# Conclusion

- **The Definition, Goals, and Scope of the ILC TDR estimate have been presented.**
- **The Value Estimating Methodology, appropriate for projects dominated by in-kind contributions, has been described.**
- **The definition of the 2012 ILCU used for the ILC TDR estimate, in terms of Purchasing Power Parity, has been described.**
- **The RDR Value estimate has been escalated and re-stated in terms of the 2012 ILCU.**