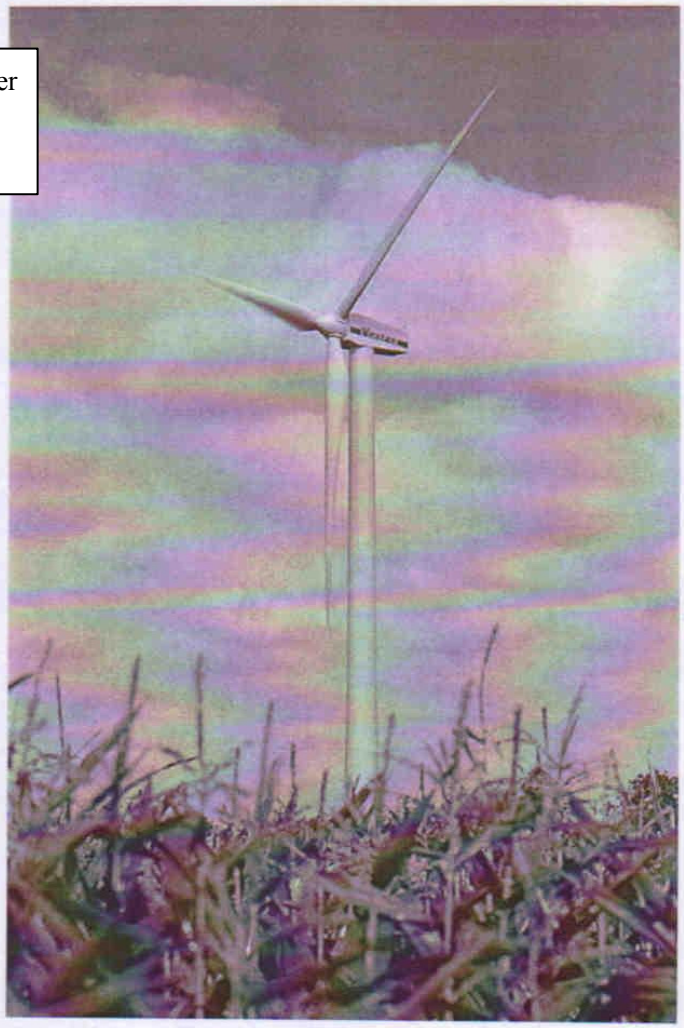
Analysis of Wind power investment



传统机械旋转式风电，由于市场的扩大、风电机组产量和单机容量的增加以及技术上的进步，使风电机组每千瓦的生产成本在过去近20年中稳定下降。80年代初期，在国外，每千瓦的造价约为3000-4000美元。而现在，按1997年国际上的批量（30台以上）售价，定桨距失速调节型300KW机组约为925美元/KW，600KW机组约为730美元/KW（含塔架及其基础件，不包括运输费用）。风电场的建设成本每千瓦装机容量约为1000-1300美元。

另一方面，由于风电机组设计和工艺的改进（如叶片翼型改进等），性能和可靠性提高，加上塔架高度增加以及风场选址评估方法的改进等，使风电机组的发电能力有相当大的增长，每平方米风轮扫掠面积的年发电量从80年代初期的400-500KW.h提高到目前的1000KW.h以上。一台标准的600KW风力发电机，当各种条件都是最佳状态时，每年可发电约2000万KW.h，即每平方米风轮扫掠面积的年发电量可达1400-1500kW.h。目前风电场的容量系数（即一年的实际发电量除以装机额定功率与一年8760小时的乘积）一般约为0.25-0.35。

In China, unit cost of wind power generation for *small and medium size* is about 10000 RMB Yuan, or even more.

综合上述史以及风电场的[illegible]如贷款利率、偿还期等），目前在较好的风场，风[illegible]火电竞争的能力。

当然，独立运行的非并网[illegible]同时容量系数较小，所以发电成本比并网型机组要[illegible]

在国内，中小型风电机的投入成[illegible]000元/千瓦左右，或更高。在风能资源特别丰富地区的大型机组，初期建设投入成本[illegible]8000元/千瓦左右。

电网企业应当全额收购取得行政许可的可再生能源发电企业电量。

对列入国家可再生能源产业发展指导目录的项目予以贷款和税收的优惠政策；

对取得行政许可的可再生能源发电企业，电网企业未全额收购其电量，造成企业损失的，应当承担赔偿责任。

虽然法规无法定量很多指标，但可以肯定的是，在上网电量消纳方面，风电有着火电不可比拟的优势，运营方面几乎不用考虑人为造成的利用小时下降。

税收优惠：对于风力发电企业，根据国家财政部、税务总局下发财税[2001]198号文件，给予增值税减半的

The average cost of per unit investment is 10000 RMB Yuan, take favorable tax and even CDM income, to achieve a reasonable profit, the electricity price is expected to be at least 0.60 RMB Yuan/kWh, but the actual bidding price is 0.50 in average.

特许招标形式拿到的惠来石碑山

业的盈利能力。我们最终的结论是

①国内早期的风电项目均是赚钱的；②特许

当年多在盈亏平衡点附近，从特许经营25年的长周期看，考虑还贷后的财务费用减少，其平

水平大致在3～6%之间，离10%的合理回报水平还有一段距离；③目前是风力发电盈利低点，风电成

能加速降低，风电必将成为一个能获取稳定合理回报的赚钱行业。

当前国内风场设备造价普遍在10000元/kw左右，在这样的设备造价下，风力发电的盈亏主要取决于电价和资源条件。在假定单位造价1万元的条件下，算上CDM收益和优惠税率，对应不同资源条件和电价，风电场的盈亏平衡和合理回报点见下表。由于国内多数风能资源年利用小时在2000小时左右，这样的资源条件，要获得合理的回报，电价水平不能低于0.60元，而实际上此等资源水平的招标项目，中标电价多在0.50元左右。

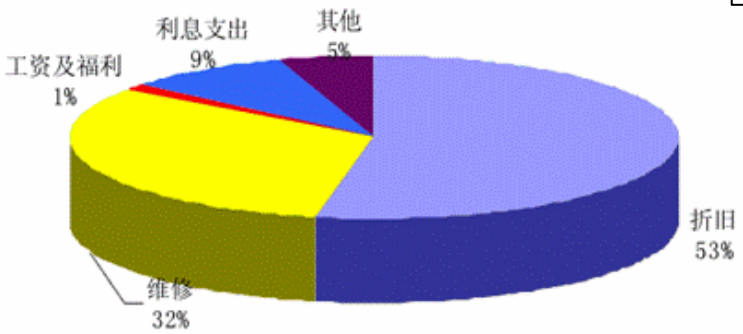
http://www.huaxiawind.com.cn/detail.asp?infoId=4194

风力发电成本

影响风力发电成本的主要因素包括：风力发电机组成本、基础及配套设施、使用寿命、风力资源、运行可靠性、电网吸纳性、年维修/管理费、税金等。风力发电成本的一般占比示意图如下所示：

Wind power generation

风力发电成本构成



（图片来源：北京大学环境经济与政策研究组）

与煤电相比，风电的成本要高33%～60%。

Compared with coal power generation, wind power generation cost is 33%-60% higher

风电成本高的原因在于：首先，固定资产折旧费高；其次，[illegible]电的固定资产折旧费是煤（20%～22%）的1倍多，但发电系数只相当于煤电的1/2。主要[illegible]物理因素的影响。

据研究，中国风电在综合考虑了装机容量、技术水平提高等因素[illegible]趋势，预测的极限成本为0.22元/kWh。而当成本到达0.25元/kWh时，风电在价格上就有[illegible]

预测的中国风力发电成本

http://www.infra-vest.com/SC/5-1-5-2.html

Qingshi Project Economic Analysis Comparison

Item	*Alternative 1）-Proposed project without CDM support*	*Alternative 2)-Import of Electricity from Grid*	*Alternative 3)-New captive power generation on-site, using* wind *energy*	*Alternative 3)-New captive power generation on-site, using* coal, diesel, natural gas *energy etc.*	*Alternative 3)- New captive power generation on-site, using* hydro *energy, etc.*	*Alternative 4) A mix of option 2) & 3), in which case the mix of grid and captive power should be specified;*	*Alternative 5) Other uses of the waste heat and waste gas.*	*Proposed project with CDM support*
Per Unit Investment/ (RMB YUAN/kW)	6MW: 7622.39 7MW: 7569.99 (Source: Feasibility Study Report, Chapter 8)	No new investment needed.	More than 10000 (Source: http://www.solar168.cn/2007/wind_power/wind_power_buy/2007123/071232315191G83AE7H11KJ606A276J.html)	Is prohibited by national regulation. <Notice on strictly prohibiting the installation of thermal power units with capacity of 135MW or below> released by State Council on 15th April 2002 (Ref. No.: GuoBanFaMing Dian [2002] (6))	There are no these kind of energy sources such as hydro energy on project site.	Alternative 3) is not feasible, so it's not feasible of alternative 4) (A mix of options 2) and 3),);	Currently, most of waste heat from clinker production has been emission into the air. The cement plant lies in southeast of China where civil heating is not demanded. There are no any other potential demands for heating or other industry utilization of the additional waste heat locally.	10 US$/tCO$_2$e; 81,491 tCO$_2$e/y;7years; Per Unit investment reducing about 3169(RMB YUAN/kW)

				(http://www.gov.cn/gongbao/content/2002/content_61480.htm) and <Temporary rules on construction management of small-scale thermal power units> (http://www.chinapower.com.cn/yearbook/article/1998/50303017.html) released by State Council in August 1997 for strictly controlling the construction of thermal power plants with capacity under 100MW.			Therefore, alternative 5 can not be taken as baseline scenario.	
Generation Cost	Compared with coal power generation, wind power generation cost is 33%-60% higher.(http://www.infra-vest.com/SC/5-1-5-2.html) For more, according to market analysis (http://www.huaxiawind.com.cn/detail.asp?infoId=4194), the average cost of per unit investment is 10000 RMB Yuan, take favorable tax and even CDM income, to achieve a reasonable profit, the electricity price is expected to be at least 0.60 RMB Yuan/kWh, but the actual bidding price is							

	0.50 in average. This also means wind power generation, especially small scales one, is not economically attractive.							
Analysis	1. High capital investment. 2. Extra jobs need to be done to require approvals from the regulatory bodies.	1. No capital investment. Electricity could be imported from East China Grid Immediately. 2. Being the existing practice, no clearances/approvals required. 3. Project owner will not face any resistance from the regulatory bodies.	1. Higher capital investment compared to waste heat power generation. 2. Extra jobs need to be done to require approvals from the regulatory bodies.					Noticeable profits from CERs and improve the financial situation greatly
Conclusion	Considering all the points mentioned above, it is clear that excluding the alternatives prohibited by law and regulations, Alternative *2) - Import of Electricity from Grid* was found to be the most economically attractive option for the project owner. And therefore, as per the methodology, this alternative option is the baseline scenario. This is further substantiated by the fact that this scenario was the status quo of existing before CDM project implementation.							