

Weather Derivatives Introduction

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Agenda

- Definitions
- Where energy derivatives are traded
- Some energy contracts traded in New York and Tokyo
- The platforms

Market Origins

- The weather market traces its roots to deregulation of the U.S. energy industry.
- Variability in weather conditions had always been recognized as one of the most significant factors affecting energy consumption, however the effects of unpredictable seasonal weather patterns had previously been absorbed and managed within a regulated, monopoly environment.
- With deregulation, the various participants in the process of producing, marketing, and delivering energy to U.S. households and businesses were left to confront weather as a new and significant risk to their bottom line.

Market Origins

- Early pioneers in the market conceived of and executed the first weather derivative transactions in 1997.
- The first deals were all arranged as privately-negotiated over-the-counter transactions and were structured as protection against warmer or cooler than average weather in specific regions for the winter or summer seasons.
- The early market participants saw weather derivatives as both a mechanism to hedge inherent weather exposure in their core energy assets and other energy commodity trading operations as well as a new risk management product to offer to regional utilities and other energy concerns alongside the array of structured products they were already providing.

Evolution of the Market

- Beyond the obvious initial applications of weather derivatives to hedging energy risk, the market has expanded to address a wide array of weather risks faced by numerous other industry sectors.
- A U.S. Department of Commerce estimate indicates that more than \$1 trillion of U.S. economic activity is exposed to the weather, and transactions over the past several years have provided weather protection to companies in sectors as diverse as entertainment, retail, agriculture, and construction.
- A sampling of weather risks faced by various industries is presented in the table below.

Evolution of the Market

Risk Holder	Weather Type	Risk
Energy Industry	Temperature	Lower sales during warm winters or cool summers
Energy Consumers	Temperature	Higher heating/cooling costs during cold winters and hot summers
Beverage Producers	Temperature	Lower sales during cool summers
Building Material Companies	Temperature/Snowfall	Lower sales during severe winters (construction sites shut down)
Construction Companies	Temperature/Snowfall	Delays in meeting schedules during periods of poor weather
Ski Resorts	Snowfall	Lower revenue during winters with below-average snowfall
Agricultural Industry	Temperature/Snowfall	Significant crop losses due to extreme temperatures or rainfall
Municipal Governments	Snowfall	Higher snow removal costs during winters with above-average snowfall
Road Salt Companies	Snowfall	Lower revenues during low snowfall winters
Hydro-electric power generation	Precipitation	Lower revenue during periods of drought

New participants

- In many ways, the weather market represents a frontier of convergence between the insurance market and the broader financial markets.
- As the market grew, it quickly attracted involvement not just of other energy traders but also of insurers and reinsurers, investment banks, and hedge funds.
- Although the insurance industry was accustomed to providing coverage for more catastrophic risks than the seasonal weather variations covered by the weather market, it found the weather market attractive for two reasons.
 - there was a close similarity between weather derivatives and traditional “mother nature” insurance products covering property damage and business interruption
 - there was a strong overlap between the skills needed to participate in the weather market and the insurance industry’s core actuarial and risk management expertise.

New participants

- At the same time, investment banks and commercial banks saw weather derivatives as a financial risk management product that they could cross-sell along with other financial products for hedging interest rate or currency risks.
- Finally, some commodity traders and hedge funds saw opportunities to trade weather on a speculative basis, or to take advantage of arbitrage opportunities relative to other energy or agricultural commodities.
- Today, all three sectors – energy trading, insurance, and the capital markets – are well represented in both trading and origination activities.

Broader product offering

- To address the needs of non-energy end-users, and to advance the variety of weather risk management capabilities available to all market participants, the range of products available in the market has been greatly expanded via continued innovation.
- Weather transactions today can be structured to cover almost any type of weather variable (temperature, rainfall, snow, wind speed, humidity, etc.), to have terms from as short as a week to as long as several years, and to have potential payouts ranging from a few tens of thousands of dollars for small risks to as much as \$100 million or more for much larger exposures.

Global development

- The weather market has quickly expanded beyond the U.S., both in terms of the types of risks being addressed and the nationalities of firms involved in the market.
- Countries in which weather transactions have been completed include the U.S., the U.K., Australia, France, Germany, Norway, Sweden, Mexico, and Japan.

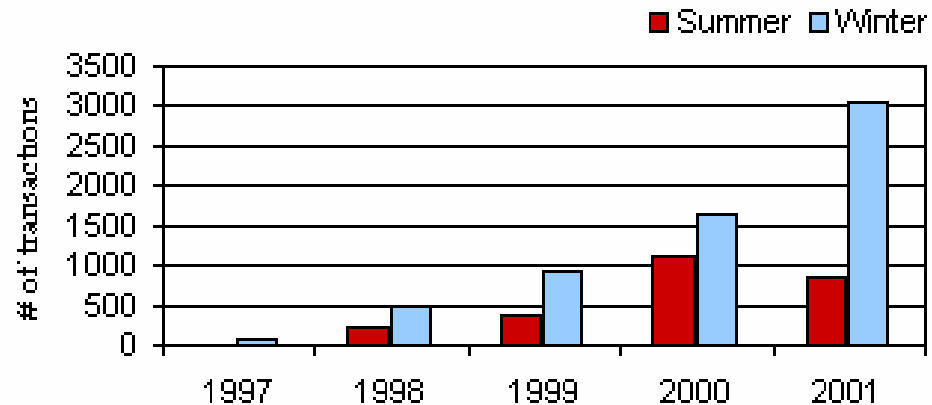
Market Statistics

- In 2002, the Weather Risk Management Association (WRMA) commissioned PricewaterhouseCoopers (PwC) to conduct the second annual industry-wide survey of weather market activity.
- This survey focused on activity in the weather risk industry from April 1, 2001 to March 31, 2002, and provided quantification of transaction volumes and of various breakdowns of trading activity.
- This year's survey found that more than 3,900 transactions occurred during the year (a growth of 43% over the previous year) and that these transactions represented more than \$4.3 billion of notional exposure.

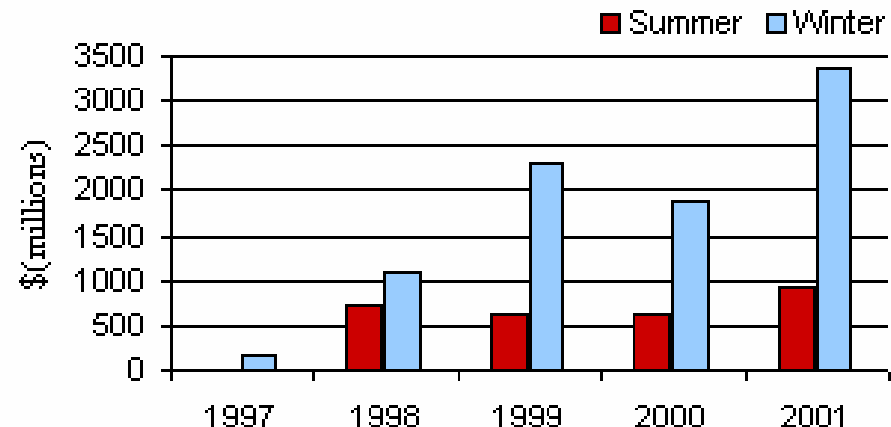
Market Statistics

- These charts show the progression by year and season in the number of weather transactions and the total notional limit of these transactions.
- Note the convention used here is that Winter 2001 refers to the period from November 2001 to April 2002.

Growth in Weather Transaction Volumes



Growth in Amount of Weather Risk Transacted

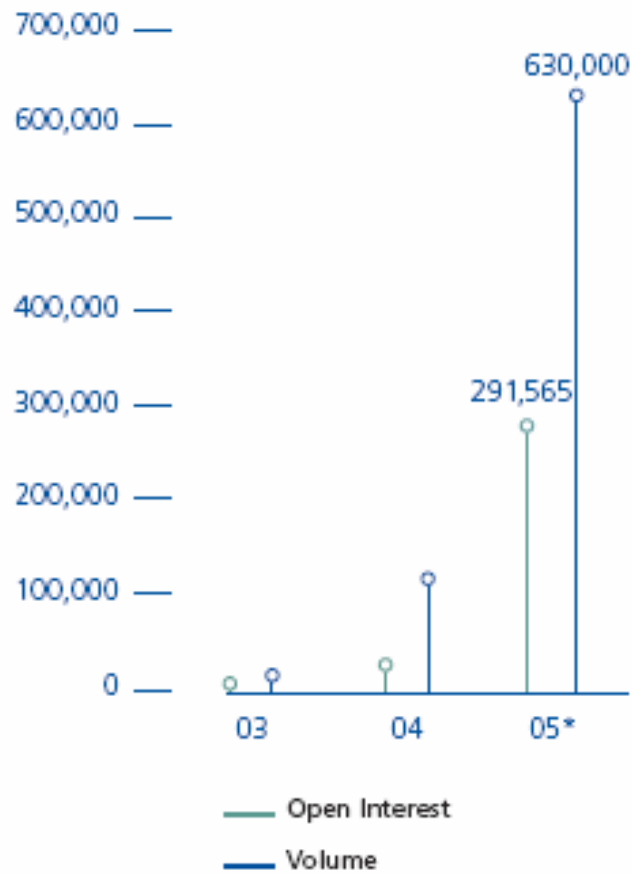


Chicago Mercantile Exchange (CME)

- Launched in 1999, CME Weather products have shown tremendous growth as the products have begun to solidify their place in the financial markets and traders have started using the products to help predict where natural gas prices may go.
- Notional value of CME Weather products in 2004 was \$2.2 billion, and grew nine-fold to \$22 billion through September 2005, with volume surpassing 630,000 contracts traded.

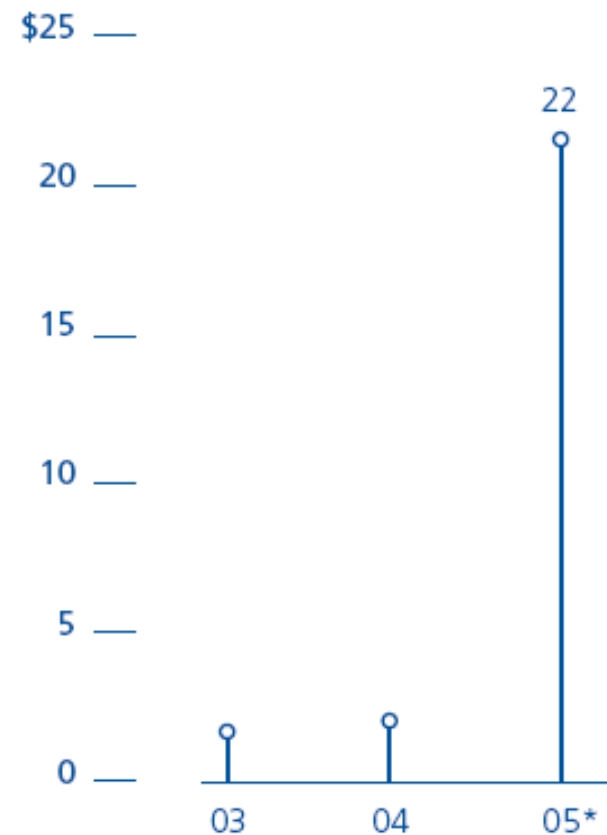
Volume, open interest and notional value at CME

CME Weather Volume and Open Interest
(Contracts Traded)



* Through September 30, 2005

CME Weather Notional Value
(\$ billions)



* Through September 30, 2005

CME products

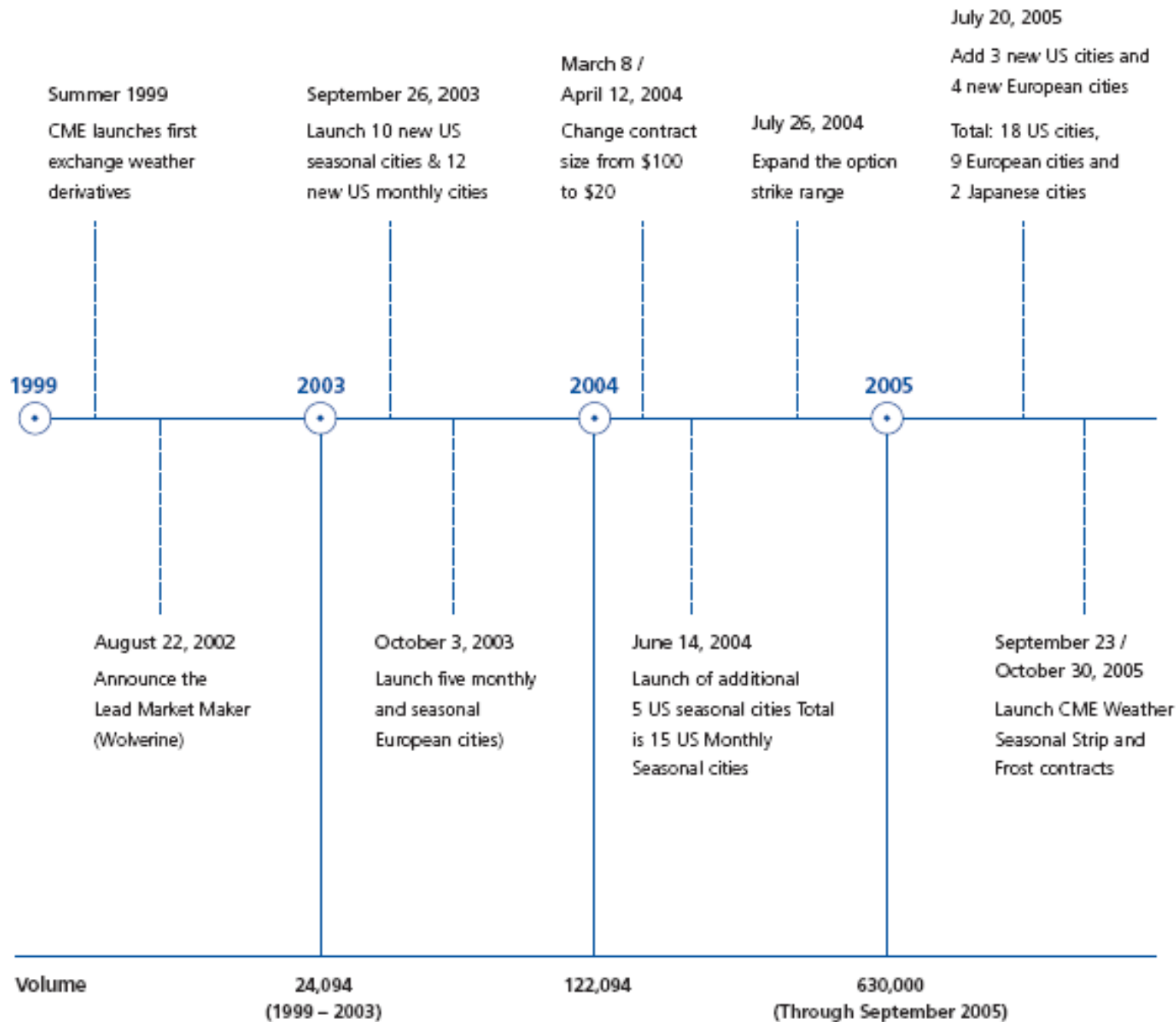
- CME Weather products are temperature-based index futures and options that are geared to seasonal and monthly weather in 18 U.S., nine European and two Asia-Pacific cities.
- CME Weather products quantify weather in terms of degrees above or below monthly or seasonal average temperatures, and attach a dollar amount to the number of degrees a month's or season's temperature deviate from an average value, based on a specific index.
- Quantifying weather makes it possible to trade weather in a way comparable to trading the varying values of stock indexes, currencies, interest rates and agricultural commodities.

CME products

- CME Weather products were the first standardized weather futures and options on futures offered on any exchange.
- Unlike over-the-counter (OTC) weather derivatives, which are privately negotiated, individualized agreements made between two parties, CME Weather derivatives are standardized contracts traded publicly on the open market, in an electronic environment and on the CME trading floor, with complete price transparency.

Amsterdam case

- CME Frost Day products are also offered for Amsterdam, the Netherlands. These products are futures and options on the number of days that frost is recorded on weekdays from November through March, and can be traded in monthly or seasonal contracts.



How Weather Derivatives Differ from Weather Insurance

- In general, weather derivatives cover low-risk, high probability events, while weather insurance typically covers high-risk, low-probability events, as defined in highly tailored or customized policies.
- Weather products are based on the fact that temperature deviations of even a few degrees can be financially damaging while not at all life threatening.
- For example, a utility company may use a Weather derivative contract to hedge against a winter that forecasters think will be 5° warmer than the historical average (a low risk, high probability event) since the company knows its revenues would be affected by that kind of weather.
- But the same company would most likely purchase an insurance policy for protection against damages caused by a flood or hurricane (high-risk, low-probability events).

Who Uses CME Weather Derivatives?

- Users of CME Weather products include companies in energy-related businesses as well as a growing number of agricultural firms, restaurants, and companies involved in tourism and travel.
- Many OTC weather derivative traders also trade CME Weather for purposes of hedging their OTC transactions.
- The CME Weather market is not necessarily about extreme weather but about the more frequent changes in weather, that while less dramatic, can seriously affect a company's bottom line.

Who Uses CME Weather Derivatives? Case 1

- A home improvement company knows that cool weather in spring means customers will not get started on spring and summer projects, and that this will have a negative effect on profitability.
- To hedge against the potential risk of a cool spring, the chain can sell (go short) CME CDD futures. They could sell at a CDD level of 400, for example, which might be close to the average in that area.
- If the weather is indeed cool and the CDD level only reaches 300, they could buy back their CDD contracts at 300, and make a profit of \$2,000 per contract (100 index points x \$20 per point = \$2,000). The profit on the weather futures could help offset the losses due to reduced sales.

Who Uses CME Weather Derivatives? Case 2

- A ski resort depends on cold weather to stay in business. To protect against the possibility of a warm winter, the resort can sell (go short) CME HDD contracts at a level they decide upon with assistance from a weather-analysis company.
- A warm winter will result in a low HDD index, and the resort will hope to buy back its contracts at a lower price and use the profit to offset losses in the business.

Who Uses CME Weather Derivatives? Case 3

- A professional trader who specializes in weather has found research indicating that hurricanes in the south and southeast often tend to lead to colder weather in the northeast in the following winter.
- After several hurricanes hit in the south and southeast, the trader decides to go long (buy) CME HDD futures, hoping that the index value will increase as temperatures plummet, and that he will be able to sell his contracts at a profit.

Benefits of Trading Weather Products

- Market integrity – By assuming the role of buyer in every CME sell transaction, and seller in every CME buy transaction, the CME Clearing House ensures the integrity of each transaction.
- It also uses sophisticated risk management and financial surveillance techniques to protect customers from the possibility of default on any transaction, i.e., the possibility that either side in a trade may not perform its buy or sell obligation.

Benefits of Trading Weather Products

- Price transparency
- Weather products offer all traders, large or small, equal access to the best bids and offers.
- Weather futures contracts are traded electronically on the CME Globex electronic platform, nearly around the clock five days a week, with complete price transparency and views of the top five bids and offers.
- The options are traded on the CME trading floor.

Benefits of Trading Weather Products

- Liquidity
- CME Weather markets are supported by automated trading systems supplying continual price feeds from global weather market makers.
- These price feeds are real-time, dealable quotes, which allow CME to provide exceptional market liquidity and a dynamic trading venue for a large pool of financial and asset managers, multinational corporations, speculators, day traders, retail investors and investment banks.

Benefits of Trading Weather Products

- Accessibility
- CME Weather derivatives are easily accessible to those seeking to take immediate market action in response to unanticipated weather situations, as well as to those in various locations around the world.

Indexes

- Weather contracts for the winter months in U.S. and European cities are classified according to an index of Heating Degree Day (HDD) values, days in which energy is used for heating.
- The contracts for U.S. cities in the summer months are geared to an index of Cooling Degree Day (CDD) values, days in which energy is used for air conditioning.
- In Europe, CME Weather contracts for the summer months are based on an index of Cumulative Average Temperature (CAT).
- Both HDD and CDD values are calculated according to how many degrees an average daily temperature varies from a baseline of 65° Fahrenheit in the U.S and 18° Celsius in Europe and Japan.
- The average daily temperature is the average of the day's maximum and minimum temperature on a midnight-to-midnight basis.

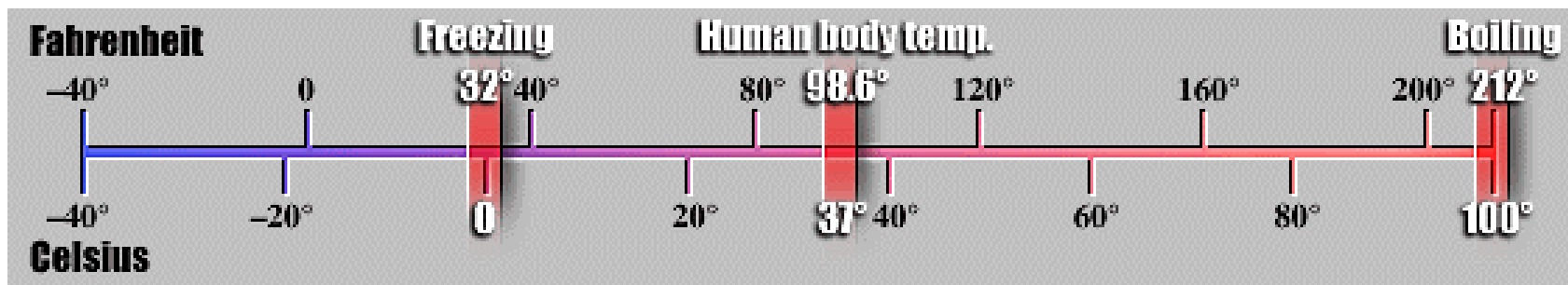
Memo

- To translate Fahrenheit degrees into Celsius the formula is

$$F = \frac{9}{5} \cdot C + 32$$

- Viceversa, to translate Celsius into Fahrenheit degrees the formula is

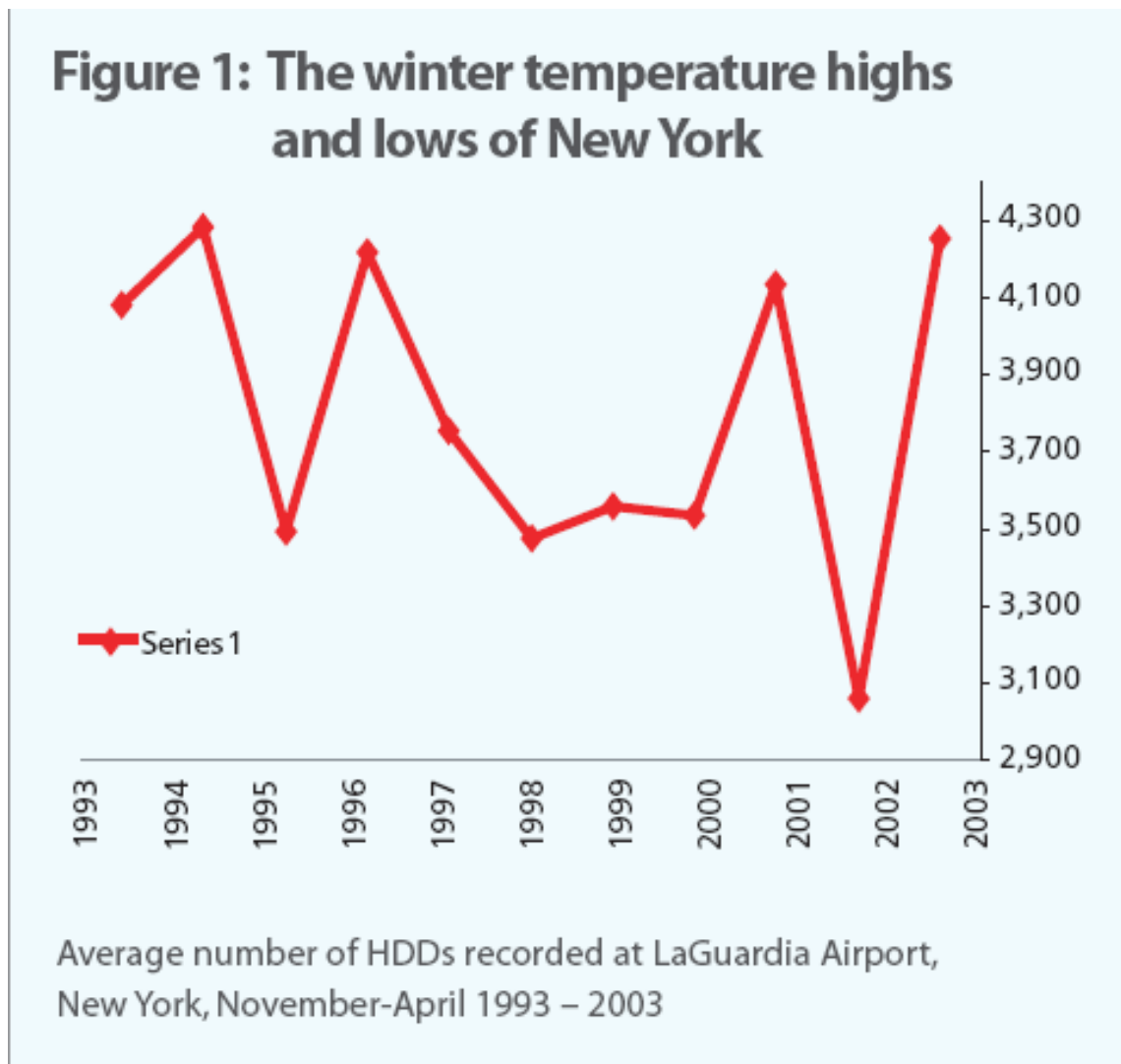
$$C = \frac{5}{9} \cdot (F - 32)$$



Measuring Daily Index Values

- An HDD value represents the number of degrees the day's average temperature is lower than 65°.
- For example, an average daily temperature of 40° would generate a daily HDD value of 25 ($65 - 40 = 25$).
- Note: If the temperature exceeded 65°, the value of the HDD would be zero, since theoretically, there would be no need for heating.

Measuring Daily Index Values



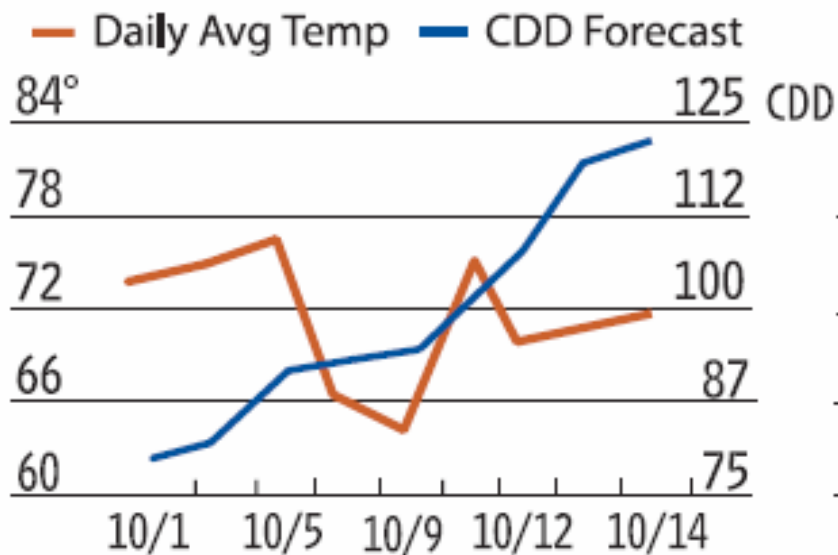
Measuring Daily Index Values

- CDD values are calculated according to the number of degrees an average daily temperature exceeds 65° .
- For example, an average daily temperature of 80° would generate a daily CDD value of 15 ($80 - 65 = 15$).
- Note: If the temperature were lower than 65° , the value of the CDD would be zero. Again, remember that in theory there would be no need for air conditioning.

The problem of weather risk

Atlanta Temperatures On A Roller Coaster Ride

Early autumn temperatures in Atlanta indicated normal levels for the month of October. Forecasts then changed to a warmer outlook that increased the value of cooling degree day futures at the CME. Traders now expect 125 CDDs, more than double the average.



	Oct '05	30-yr avg
Temp	69.0°	62.3°
CDD	125	57.5
Value	\$2,500	\$1,150

*For information about weather futures please visit www.cme.com/weather.

Measuring Monthly Index Values

- Monthly HDD or CDD index values are simply the sum of each daily HDD or CDD value recorded during a given month or season. For example, if there were 10 HDD daily values recorded in November 2005 in Chicago, the November 2005 HDD index would be the sum of the 10 daily values.
- Thus, if the HDD values were 25, 15, 20, 25, 18, 22, 20, 19, 21 and 23 the monthly HDD index value would be 208. The value of a CME Weather futures contract is determined by multiplying the monthly HDD or CDD value by \$20. Using the example above, the CME November Weather contract would settle at \$4160 ($\$20 \times 208 = \4160).

An example

- One common form of weather derivative is a put option providing protection against a warm winter. Such a transaction might look like this:
- Reference weather station: Chicago O'Hare International Airport
- Underlying index: Heating Degree Days
- Term: Nov. 1 – Mar. 31
- Structure: Put option
- Strike = 4850 HDDs
- Tick size = \$5,000
- Limit = \$1 million
- Premium \$150,000

An example

Contract payoff diagram (net of premium)

