State and Trends of the Carbon Market

Prepared for PCF*plus* Research
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On the basis of material provided by
Natsource LLC, *CO2e.com LLC* and *Point Carbon*

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Outline

1. What is the carbon market?
2. Overall Market Activity
3. Project-based emission reductions
4. Allowance markets
5. Carbon finance in developing countries
6. Outlook

Appendix: Methodology

1. Definition

What is the carbon market?

- There is **no single carbon market**, defined by a single commodity, a single contract type or a single set of buyers and sellers.
- What we call "carbon market" is a **loose collection of diverse transactions** through which quantities of greenhouse gas (GHG) emission reductions are exchanged.
- Information is limited**, especially on prices**, since there is no central clearinghouse for carbon transactions. As such, it is **difficult to compare prices and quantities over whole market.**

Many ways to look at this market

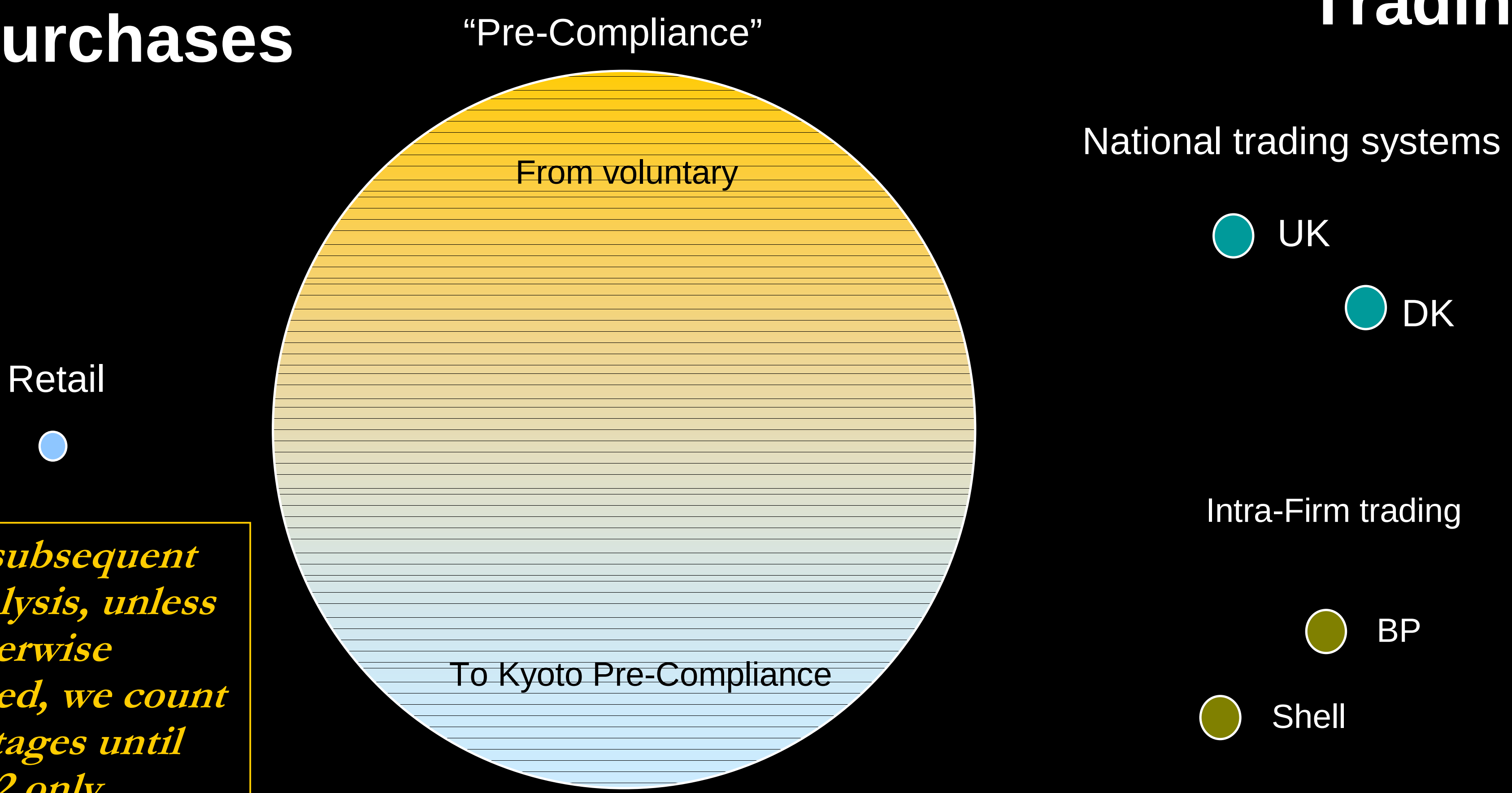
1. **By commodity traded**
   - **Project-based GHG emission reductions** (ERs), created and exchanged through a given project or activity
     Examples: most transactions to date, e.g. by PCF, Oregon Trust Fund, etc.
   - **GHG Emission Allowances**, as defined, or expected to be defined under international, national, regional or firm-level regulations
     Examples: UK trading system, BP or Shell internal trading
2. **By volumes**
   - **Wholesale**: Large transactions, usually > 1 MtCO2e
     Examples: most projects to date
   - **Retail**: Deals are in the '000s of tons
     Examples: Carbon-neutral events, non-carbon intensive corporations, etc.
3. **By types of contracts** (*e.g. spot, forward, options, swaps*)
4. **By timeframes** (most contracts: 10-14 years; some 50+ years)

Our reference for this analysis

Carbon market by commodities

Project-based Emission Reduction purchases

Allowance Trading



In subsequent analysis, unless otherwise noted, we count vintages until 2012 only

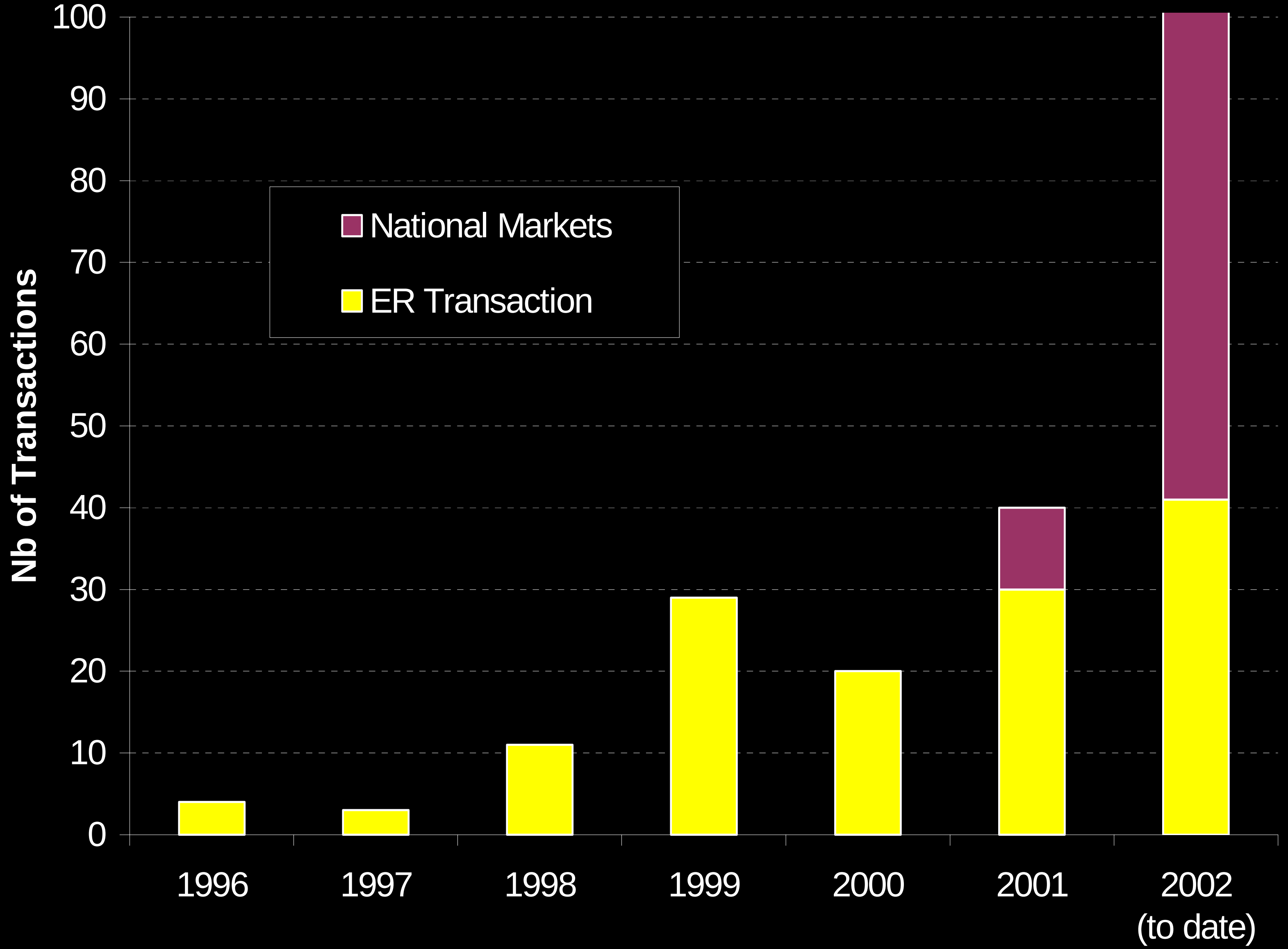
2. Carbon market is firming up

Data shows carbon market is growing

- **The past year has been the most active GHG market to date**
  - volume traded in first half of 2002 already exceeds overall 2001 volume (24 MtCo2e transacted, 103 deals, see slides #9 and #10).
- Based on closed and pending deals, **total 2002 volume could be in the range of 60-70 MtCo2e**.
  - Conservatively, this could represent a 4 to 5 time increase in volume over the previous year's volume of 12 MtCo2e.
- This is significant compared to **157 MtCO2e transacted overall since 1996** (190 MtCO2e if post-2012 vintages are counted).

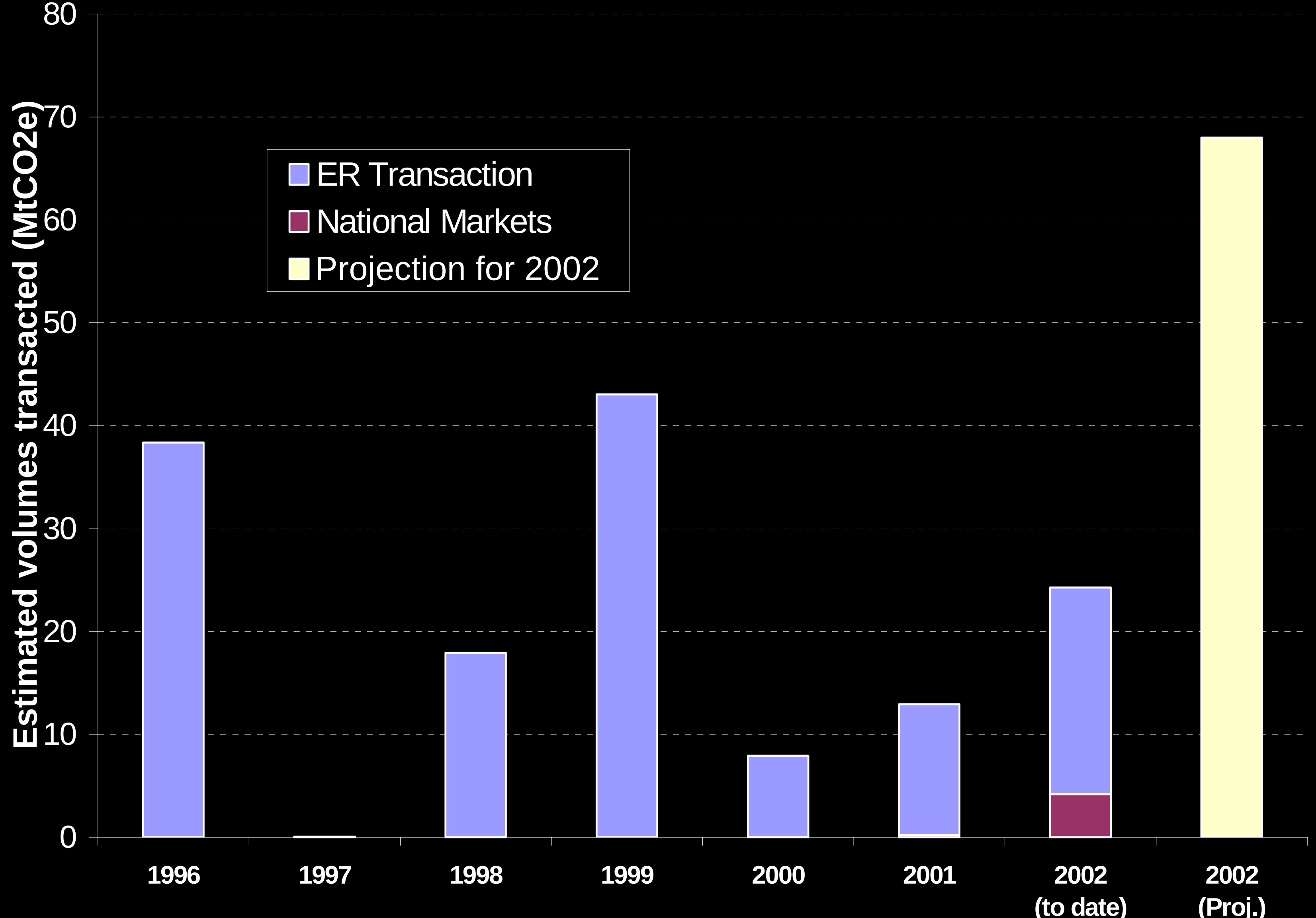
Description of the data on which this analysis is based are provided in ***Appendix I***

Number of trades 1996-2002



Source: Authors' own calculation, based on transaction database assembled with Natsource, Co2e.com and PointCarbon

Volumes transacted 1996-2002



Above volumes reflect only vintages up to 2012. We choose not to count carbon produced beyond.

<u>Source</u>: Authors' own calculation, based on transaction database assembled with Natsource, Co2e.com and PointCarbon

Evidence indicates market maturing

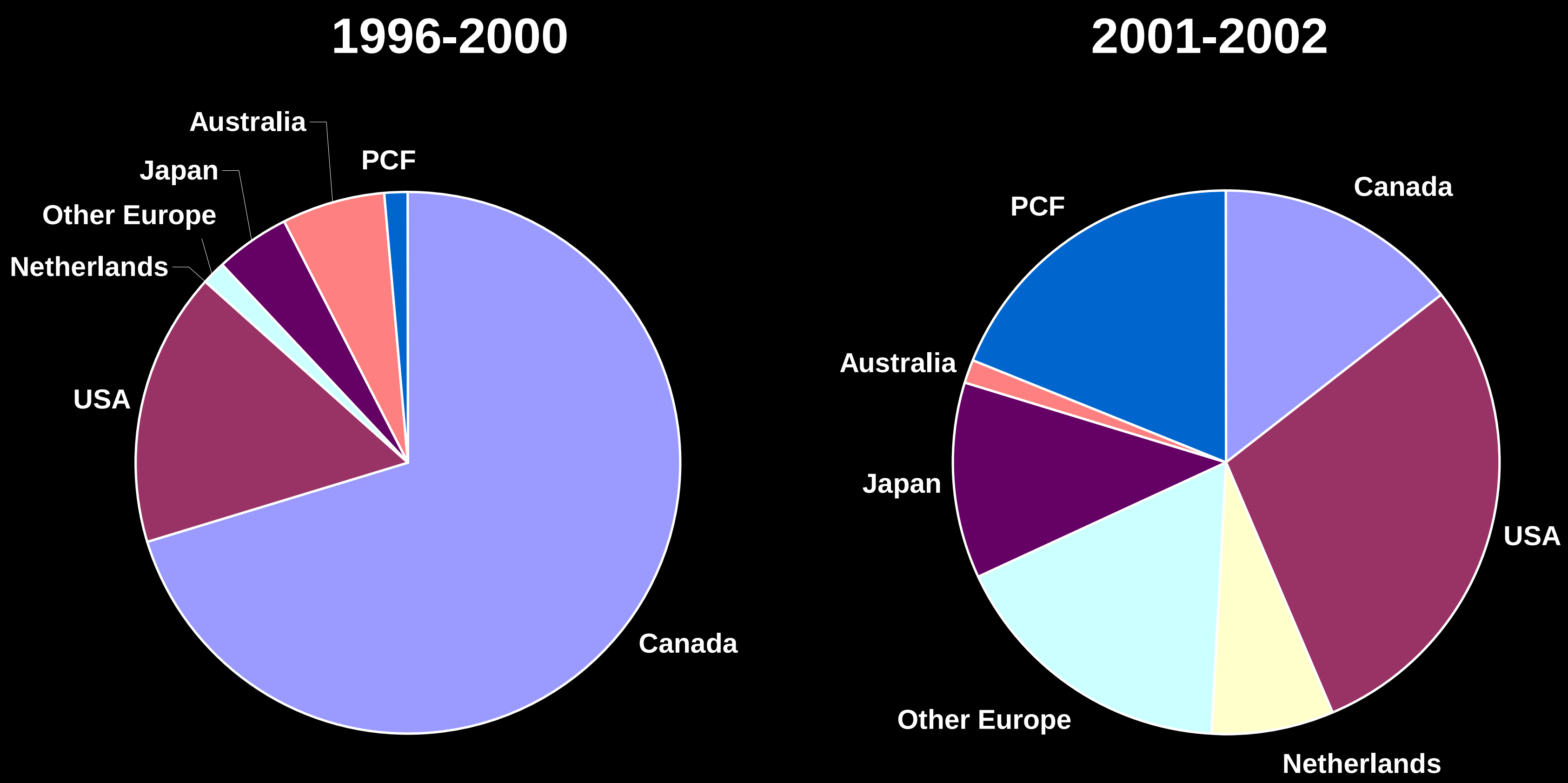
- **Project-based transactions still dominate** (85% of 2002 volume), **but GHG allowances (UK and Denmark) are now traded**
  - Volumes in the UK spot market in 2002 are projected to be almost 1 MtCo2e (see section 4)
- **A secondary market is emerging**
  - Some companies experiment with liquidating small quantities of reductions from their portfolio; demonstrate possible emergence of secondary market
- **A small but growing retail market for high quality tons is emerging**

Evidence indicates market maturing

- **More buyers are coming in**
  - European and Japanese buyers are now more active in what had been a predominantly North American buyer market (see slide #13)
  - Public buyers including sub-national entities and national governments emerge, especially for CDM/JI transactions
- **Contract types become more diverse**
  - Call options represented between a third and a half of project-based volume transacted in 1999-2001, but less than 20% of 2002 volume.
  - Forward contracts now dominate project-based transactions, with a growing share of payment on delivery (as opposed to upfront payment).
- **Wider span of technologies explored in project-based transactions** (see slide #14)

Who's buying contracts?

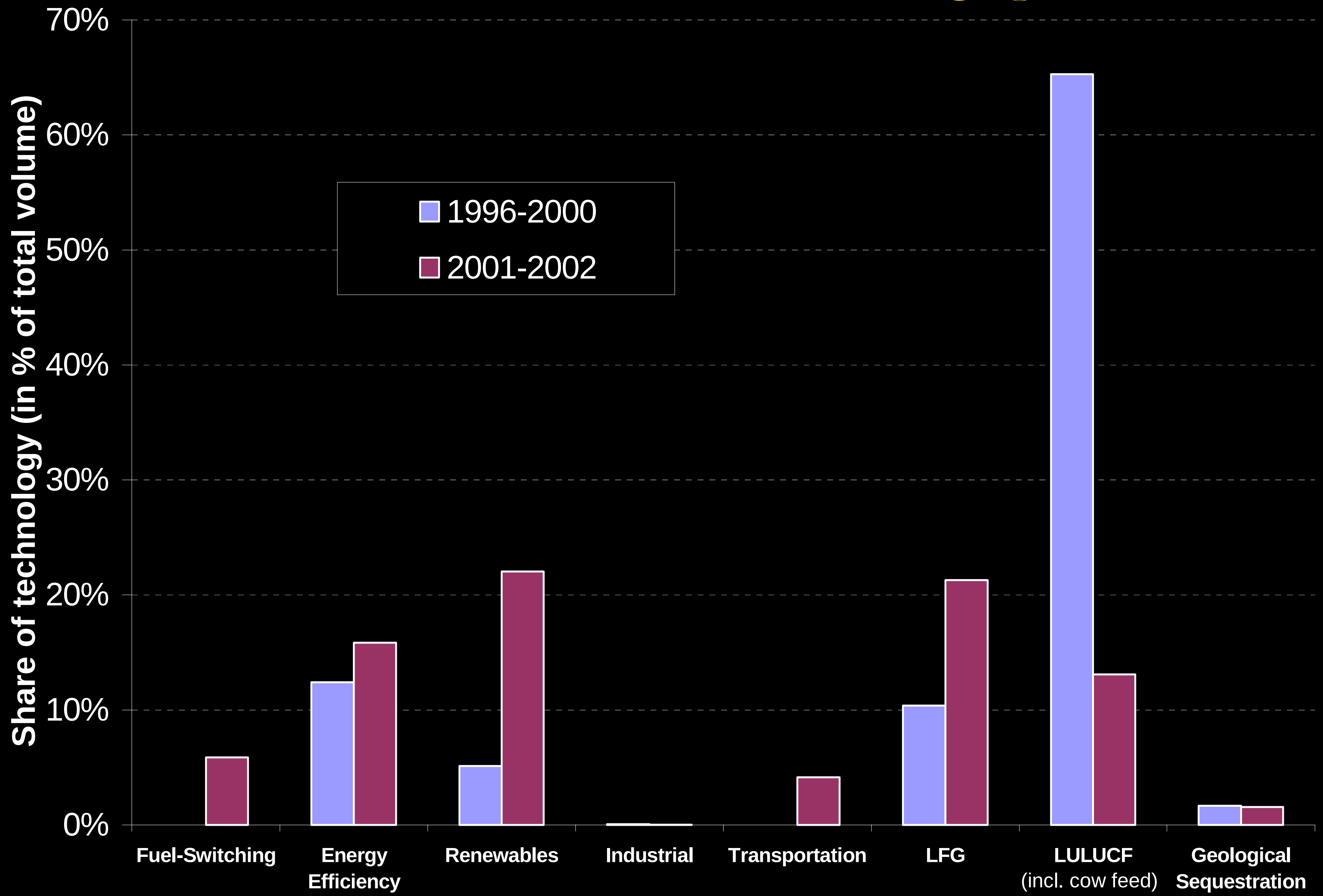
(in % of total volume purchased through projects)



Source: Authors' own calculation, based on transaction database assembled with Natsource, Co2e.com and PointCarbon

What are they buying?

(in % of total volume transacted through projects)



Source: Authors' own calculation, based on transaction database assembled with Natsource, Co2e.com and PointCarbon

Total value of the carbon market?

- **There is incomplete data**
  - 95% of transactions in database have volume information, but only 50% -- representing 20% of volume -- have prices
  - In some cases, these are options which is unclear whether exercised or not
- **To obtain a crude estimate of the total value of market**
  - We multiply prices*quantities for transactions where we have both
  - We apply average price of transactions with prices to the others
- Result suggest that **total value of know transactions, for vintages up to 2012**, could be in the range of **$350m to $500m**. Data is insufficient to estimate how much of that amount has effectively changed hands.

What fuels this growth? Expected (or effective) emission limits

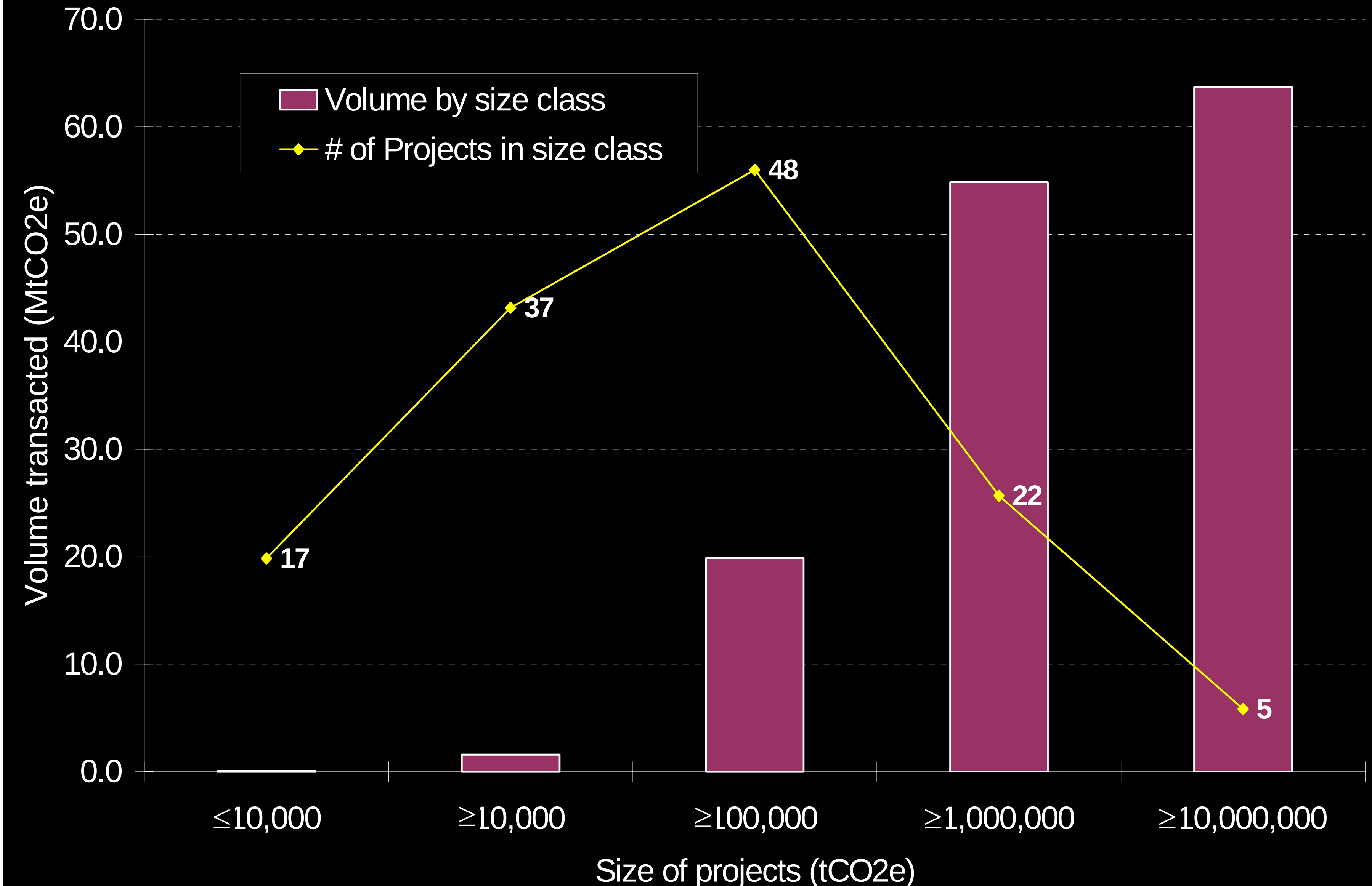
- **Kyoto entry into force now likely**
  - EU, Japan, China, India and Brazil have ratified, Canada says it will submit KP to parliament by end of 2002, and Russia says it will ratify. If Russia and Canada ratify, the KP enters into force.
- **GHG regulations before 2008 in Europe**
  - UK, Denmark system already in place. Other systems at advanced stage of design (e.g. Norway). EU-wide trading in discussion for 2005.
- **GHG programs emerging at State and sub-national levels even outside Kyoto**
  - E.g. Alberta, Massachusetts, possibly California, New South Wales
  - E.g. California bill regulating greenhouse gas emissions from automobiles, including SUVs and light trucks.

3. Prices and quantities in project-based transactions

Project-based transactions: key facts

- **Project-based ER purchases constitute bulk of carbon market**
  - They represent 2/3 of transactions, but 97% of volume since 1996
  - Still 85% of volume in 2002
- Canada (and to lesser degree USA) main buyer, but European and Japanese are now more active
- Projects used to be mostly LULUCF (incl. cow feed), now **more evenly distributed among technologies**
- **Contract types are becoming more diverse**
- **Projects usually rather large**, plus small retail market (slide #19)
  - Majority between 0.1 and 1 MtCo2e
  - Average project-based ER purchase of 1MtCo2e

Distribution of projects by size



Source: Authors' own calculation, based on transaction database assembled with Natsource, Co2e.com and PointCarbon

Uneven price signal

- **JI Countries**: Prices available for PCF & ERUPT deals, which represent bulk of recent volume in these countries.

  Range: \$3.00-\$8.10

- **CDM**: Prices available mostly in PCF deals (4 other transaction with price, small volume) although they represent only 1/7 of volume since 1996 (but 70% of 2001-2002 purchases).

  Range: \$1.48-\$3.50

- **Annex II (OECD)**: Prices available in 37% of deals, representing about 1/6 of volume exchanged since 1996.

  Range: \$0.40-\$7.30

  Average: \$1.00/tCO2e

Qualitative Price Determinants

There is insufficient data to conduct definitive quantitative analysis on determinants of price in transactions[1]. Based on experience & insights from market experts, key ER price determinants include

- Likelihood that ER is certified under KP or other regime
- Creditworthiness of project sponsor and viability of project
- Confidence in the quality of the ongoing carbon asset management over life of project
- Structure of contract (e.g. spot vs. forward, upfront vs. payment on delivery)
- ER Vintage
- Cost of validation and potential certification
- Additional environmental and social benefits

[1] In our database, small sample and limited information makes it impossible to numerically sort out influence of different parameters on prices.

Role of non-carbon attributes

- Sustainability benefits from ER projects in the carbon market are often cited by sellers and desired by buyers, although a premium is not clear in the wholesale market
- Examples of non-carbon attributes sought by buyers:
  - Enhanced water quality, health and education facilities, job creation
  - Reversal of soil erosion, habitat creation and enhancement of conditions for biodiversity
  - Capacity building and technology transfer

Trends in contract structures

There is limited information on deal structure. Based on insights from market players, we conclude that:

- **In early transactions (1996-2000)**
  - Most contracts either call options (of which many seem not to have been exercised because of uncertainty),
  - Or spot contracts for voluntary commitments.
- **In recent transactions (2001-2002)**
  - Call options represented between a third and a half of project-based volume transacted in 1999-2001, but less than 20% of 2002 volume.
  - Forward contracts now important share of contracts, with a growing share of payment on delivery (as opposed to upfront payment).

Features of recent deals

- Several recent transactions based on "payment on delivery"
- Combining forward purchase with option for additional volumes and vintages is common
- In a handful of contracts, an upfront payment is negotiated and sellers repay payment + interest with cash and ERs.
- In a few transactions, the seller guaranteed delivery of CERs. Such a guarantee commands a price premium.
- In some instances, the buyer of ERs may also have significant equity or debt interests in the underlying project.
- Some transactions secured a less secure stream of assets with a guarantee from a more secure stream.

Retail Market

- **Small but growing market. Not for compliance, but ERs** retired (e.g. non-carbon-intensive corporations, individuals, particular products or services, carbon-neutral events, etc.)
- **Spot or short-term forwards - up to 3 years.**
- NGOs frequently used as verifiers who give a "seal of approval" to projects that satisfy their environmental and social criteria
- Key buyers are North American companies and suppliers are predominantly from developing countries
- **Higher prices ($5 - $10)** are being paid for small volumes of ERs (usually small projects producing under 10,000 tons) from sustainable development projects in the retail market
- **The volume of this market is estimated in the range of 150,000 tCo2e/year** and growing very rapidly.

4. Overview of allowance markets

Markets developing worldwide

Allowance Markets in operation

- UK, Denmark
- Internal Markets BP, Shell

Allowance Markets under development

- Regional level:
  - EU-wide market (expected by 2005 or 2006)
  - New England Govs/Eastern Canadian Premiers initiative - still tentative
- National level (e.g. Norway)
- Sub-National level:
  - US/Australia
  - California, Massachusetts, New Hampshire
  - New South Wales
- Voluntary Markets (e.g. Chicago Climate Exchange, embryonic)

UK Market

- Allowances sold to companies through **reverse auction in 03/2002**: 4 $mtCO_2e$ sold at \$17/tCO_2e (net of incentive payment)
- Early trades mostly among ”absolute” participants. Volume has been increasing (100 trades recorded) as ”relative” participants try to keep climate levy rebate.
- Total volume since trading began in April estimated at 100,000 tCO_2e in 2002.
  - Mainly spot or 1 yr forwards contracts
  - Typical size: 5000-15000 tCO_2eq, mainly 2002 vintage
- Early prices were around \$7-\$9. There are indications that **prices have been increasing (currently around £12, or \$18)**. UK is considering inclusion of international CDM/JI credits next year

Danish Market

- Power sector cap; expires in 2003; possible extension until 2004 and modification in 2005 to adapt to EU-wide system
- 15 transactions recorded until July 2002
  - 11 trades, 4 swaps, total estimated volume 460,000 tCO_2e
  - Typical size: 5000-15000 tCO2e
  - Price: US $2-4.60 tCO2e
  - Immediate settlement; mainly current vintage
- Non-compliance penalty: $5-6/tCO2e serves as price cap
- Companies exploring JI & CDM options

Sub-national Markets

Sub-national emissions trading programs have emerged in Australia and in North America:

- **New South Wales, Australia**, has required electricity retailers to reduce emissions. One option is to purchase Australian forestry sequestration certificates.
- **On July 1, New Hampshire** will require fossil fuel plants to reduce CO2 emissions. Participants can use allowances from federal or regional trading and banking programs to meet the cap.
- **In Massachusetts**, 6 fossil-fueled power plants are covered under the state's Certification and Trading of Greenhouse Gas Emission Reduction-- rules are under development. At least one trade reported to have occurred that we are aware of.
- **Alberta, Canada**

5. Outlook

Summary of trends identified in previous sections

- Volumes transacted in 2002 are likely to be at least 4 times higher than volumes transacted in 2001
- The UK spot market may overtake the North American market in terms of number of trades executed. However, volumes remain small.
- Significant increases in pre-compliance trading could shape legislation in other jurisdictions

Near-term market drivers

- Canada and Russia decision to ratify, and likely Kyoto Protocol entry into force.
- Specifics of EU trading program
- Political developments in the US vis-à-vis climate change and energy
- Degree to which voluntary and sub-national or regional market emerge
- Likely direction of and participation in negotiations for second commitment period.

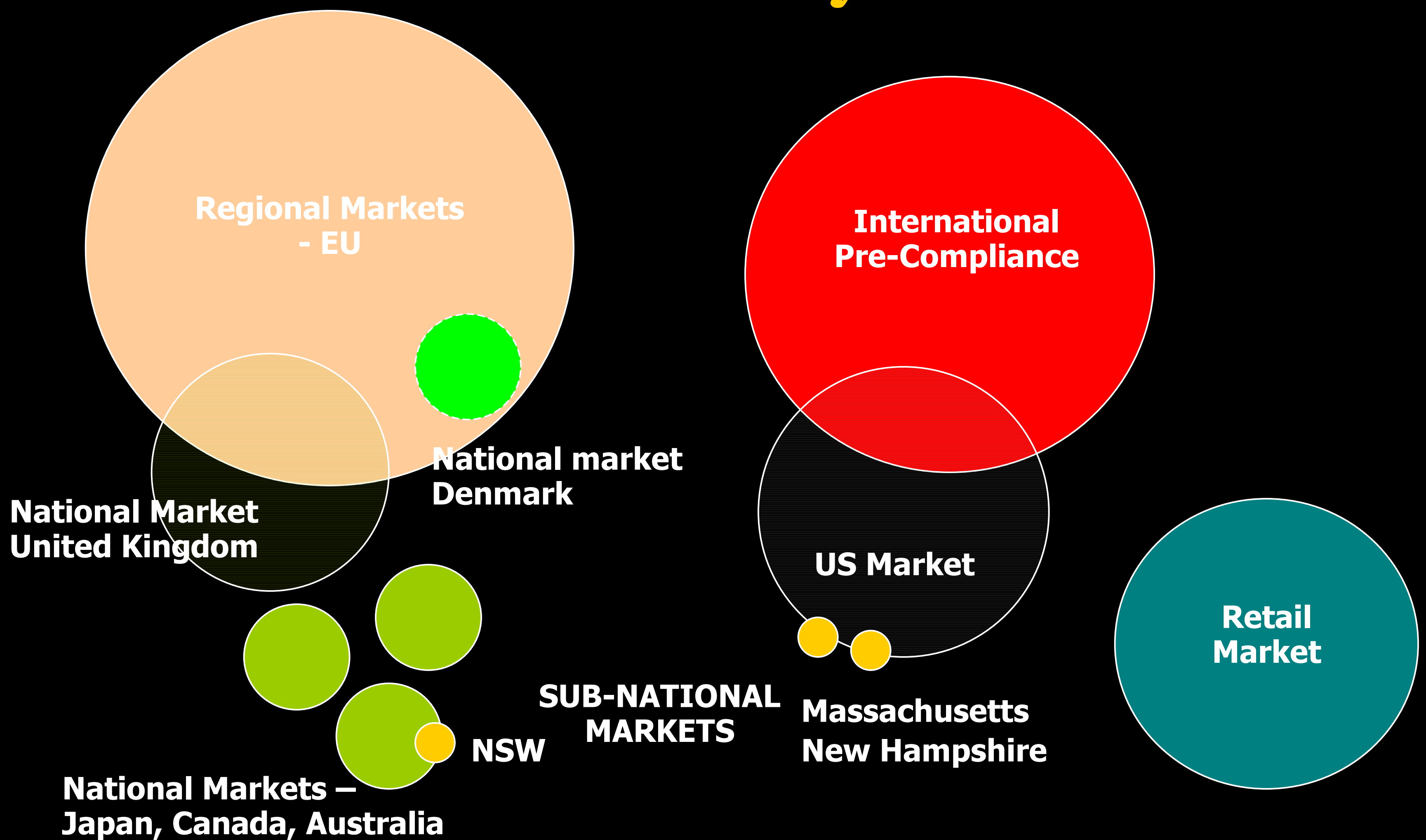
EU Directive on emissions trading proposal

- **Key features**: Mandatory, Absolute target, % unknown
  - 2005-2007, 2008-2012, CO2 only, Trading system likely to cover about ½ of EU emissions.
  - Trading to cover Industrial & energy sectors; not chemicals
  - Allocation by grandfathering 2005; perhaps up to ¼ auctioned
  - Inclusion of projects (internal/external tbd by 2006). CDM likely in pilot phase, sinks not likely.
  - Financial penalty: 2005-2007: € 50/tC; 2008-2012: €100/tC
  - Environmental Penalty: 1 for 1 deduction for overage
- If Directive comes into effect, prices in trading market will be determined by targets, system design.
- Assuming –7% target, internal trading in expanded EU: some experts estimate potential price around \$4.5-\$10 tCO2e in 2005-07

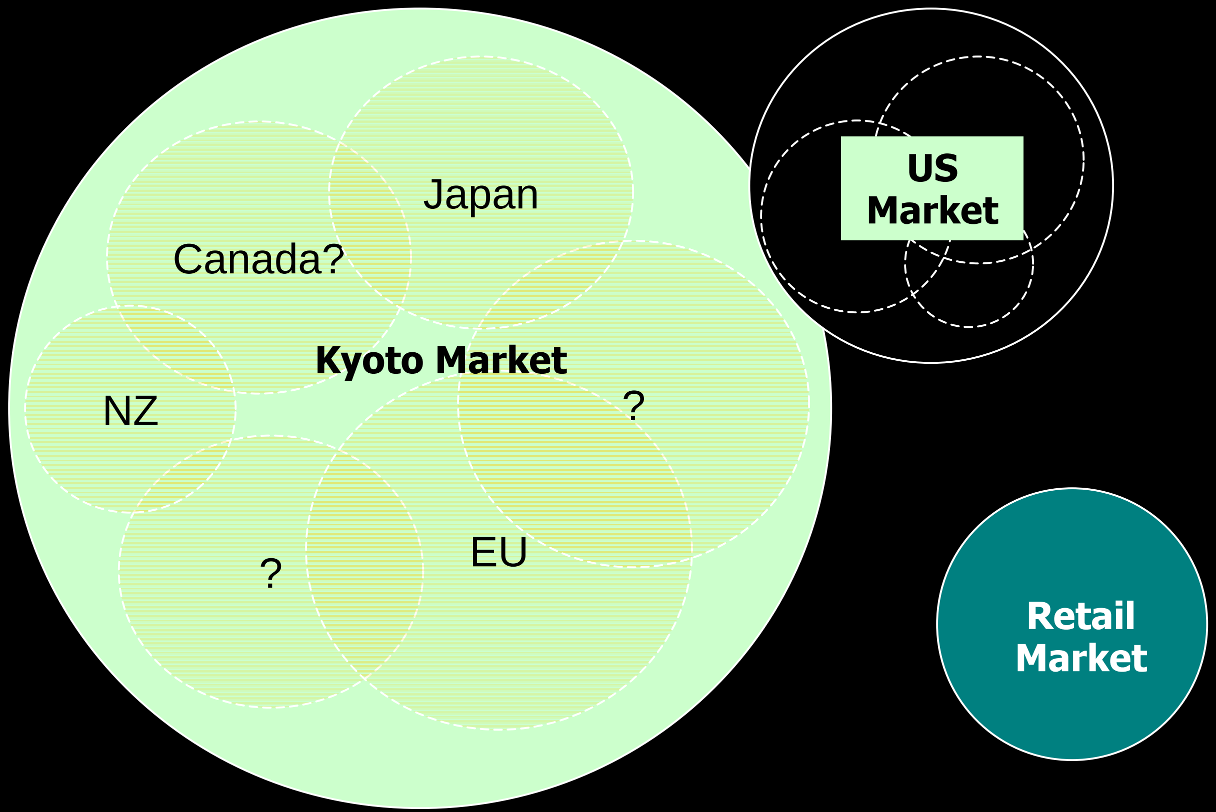
Key issue in medium/long run Fragmentation or integration?

- **Kyoto Protocol entry into force could be decisive to unite European, Japanese + Canadian markets** at 2008 horizon
  - However, rules for interchange/fungibility of existing instruments need to be developed
  - In addition, transition from 2002 to 2006 is unclear.
- CDM Project costs could provide price signals in
  - Kyoto market, Denmark, UK, voluntary markets
  - Potentially also EU 2005-8, depending on the final directives
- **Other segments of the market may remain fragmented**
  - Esp. US State-markets such as Massachusettes, New Hampshire, California
  - US Domestic Market emergence -- project-based?

What the carbon markets could look like by 2006



What the carbon market could look like by 2010

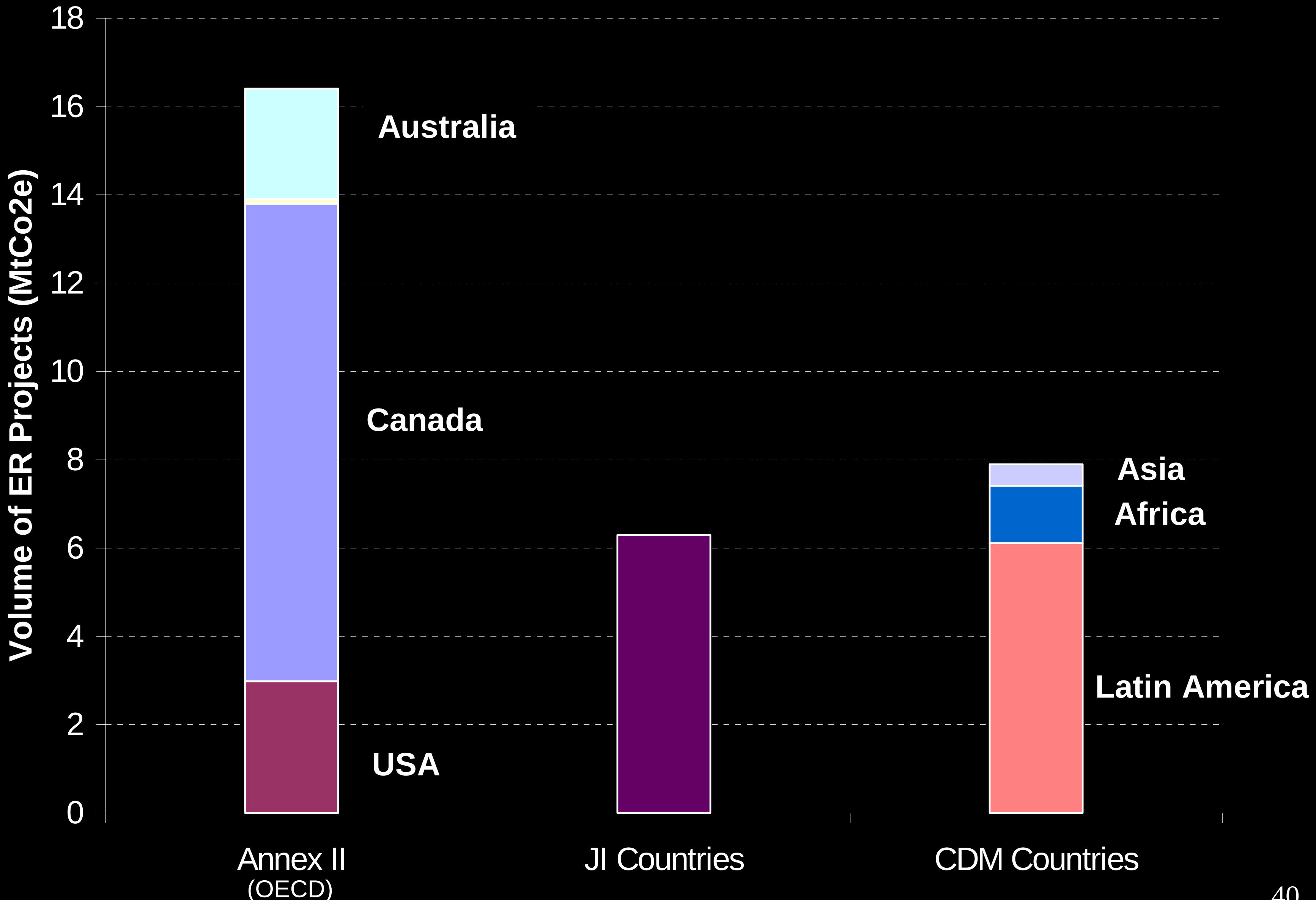


Determinants of 2008-2012 market prices, assuming Kyoto

- Strategy of likely AAU Sellers (e.g. Russia, Ukraine)
- Likely Participation of major countries in Second Commitment Period, including USA and Australia
- EU policy to ”close” or ”limit” imports from
  - a) CDM b) ”hot air” c) trade from non-Parties
- Role of ‘Relative Targets’, if any, in the future and integration with Flexibility Mechanisms
- Ability of CDM to meet likely demand in 2008-12, given project lead time

6. Do developing countries benefit?

Carbon finance flows 2001-2002



<u>Source</u>: Authors' own calculation, based on transaction database assembled with Natsource, Co2e.com and PointCarbon

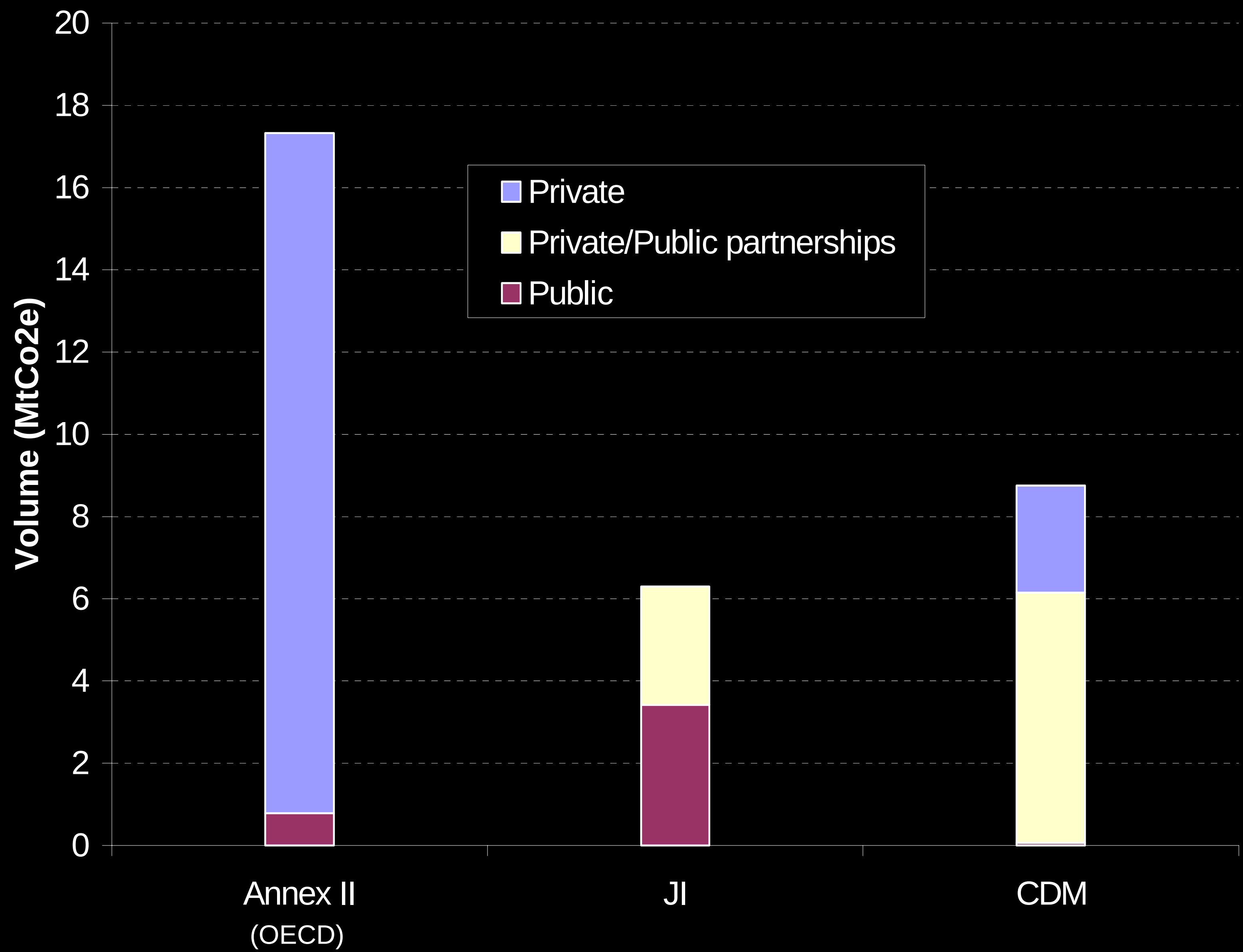
Overall, OECD supply only slightly higher than JI/CDM combined…

- Canada still by far largest supplier of ERs (about a third)
- Slightly less than half (45%) of project-based transactions in past 2 years in developing countries or in economies in transition
  - 19% in economies in transitions
  - 26% in the developing world
- Data indicate no significant increase of JI/CDM share from early years of market

…But limited private sector flows to developing countries

- **Only 13% of the private sector's purchases in 2001-2002 came from projects in developing countries**, the rest coming from OECD countries (In 2002 alone, the number was 16%)
- Bulk of recent transactions in the developing countries come from **public-private partnerships** such as the World Bank's Prototype Carbon Fund and from **public resources** committed by governments such as The Netherlands, States or Provinces
  - 70% over period 2001-2002
  - Nearly all recent transactions in the JI world come from these sources
- In addition, African countries, smaller countries and small-scale projects were largely bypassed by carbon finance

Public/Private purchases by region



Source: Authors' own calculation, based on transaction database assembled with Natsource, Co2e.com and PointCarbon

Possible factors constraining private capital flows to JI/CDM

- Linked to overall decline in foreign direct investment
- Higher risks perceived in macro-economic climate in many developing countries
- Long lead-time to prepare projects
- Transaction Costs perceived to be higher

Appendix: Methodology

Data sources

- As indicated early on, there is currently no central clearinghouse where transactions on the carbon market are recorded. Most of the transactions to date are not made public.
- To overcome this data shortage, the PCF*plus* Research program commissioned Natsource LLC, CO2e.com LLC and Point Carbon to provide us with public and confidential transaction data, and with their views on the emerging carbon market.
- PCF*plus* Research team also interviewed international companies active in this market.

Data processing

- We merged data obtained from these various sources and corrected for double-counting. In the few cases where ambiguities remain, we adopted the conservative approach of not counting the items at all.
- When feasible, the characteristics of transactions were double-checked with public sources.
- **Our coverage, although extensive, is likely still incomplete**. Some transactions, for example, are likely confidential, and others difficult to verify. **As a result, we may have underestimated the size of the market.**

Final transaction database

- The resulting transaction database (confidential) contains 138 items in the project-based section (from 1996 to Q2 2002) and 72 in the allowance trading section (from 2001 to Q2 2002).
- Quantities are adjusted to reflect vintages transacted up to 2012 only (i.e. up to the end of Kyoto first commitment period). When exact distribution of vintages was not known, an uniform distribution was assumed. This mostly has an impact on a few early large deals which spanned over 40 to 50 years (from 1996 to 1999).

PCF*plus* Research

PCF*plus* is a research, training, and outreach program designed to complement the World Bank's Prototype Carbon Fund (PCF). While an important goal of the PCF is to disseminate its experience, PCF objectives and resources restrict its research and outreach activities to those directly associated with project implementation. PCF*plus* is intended to assist PCF stakeholders (staff, participants and host countries), and the international community at large in understanding the complex issues related to the implementation of markets for project-based greenhouse gas emission reductions under the Clean Development Mechanism (CDM) and Joint Implementation (JI), with a view to reducing transaction costs and risks of doing business in the emerging GHG market.

The research component of PCF*plus* brings a unique set of strengths to the climate change research arena. Most importantly, it will be able to draw on and elucidate the lessons of PCF's pioneering activities. Its location in the World Bank enables it also to link with a wide range of climate-related programs, including the National Strategy Studies on JI/CDM, Bank-administered GEF projects in the climate area, and the broad range of Bank projects and studies involving energy and land use. PCF*plus* Research is administered by the Bank's Research Group DECRG, providing extensive in-house expertise in environmental economics, public finance, and development economics, and ensuring analytical rigor.

For more information, please visit our website www.prototypecarbonfund.org (PCF*plus*, then Research)

Completed PCF*plus* Research Studies

plus

Available online at www.prototypecarbonfund.org in the PCF*plus* / Research Section.

1 – Preliminary Validation Manual

2 – Could carbon financing appreciably accelerate the diffusion of Solar Home Systems?

3 – Regulating the CDM using a Commodity Market Model

4 – Review and Analysis of the Emerging Greenhouse Gas Market

5 – Regulatory Drivers of the Carbon Market – Market Intelligence Issue #1

6 – Regulatory Drivers of the Carbon Market – Market Intelligence Issue #2

7 – Joint Implementation in the context of EU accession – the case of the Czech Republic

8 – Regulatory Drivers of the Carbon Market – Market Intelligence Issue #3

9 – Regulatory Drivers of the Carbon Market – Global Executive Summary

10 – Applying sustainable development criteria to CDM projects: the PCF experience

11 – Energy efficiency projects bundled through intermediaries

12 – Methane emissions from woodwaste stockpiles