The Science of Climate Change

2001 – Academias:

Austrália, Bélgica, Brasil, Canadá, Caribe, China, França, Alemanha, Índia, Indonésia, Irlanda, Itália, Malásia, Nova Zelândia, Suécia e Reino Unido.

1. Lembra que em 2000, em Tóquio, 63 Academias do IAP alertaram sobre as mudanças climáticas que põem em risco a sustentabilidade da vida no planeta.

2. Reafirma que são corretos e da melhor ciência os estudos e conclusões elaborados pelo *Intergovernamental Panel on Climate Change* (IPCC).
Aumento de 1,4º a 5,8º entre 1990 e 2100.

3. Apela para que os indivíduos, as empresas e os governos tomem medidas prontas e enérgicas para reduzir a emissão dos gases do efeito estufa e que mais países, além dos 84, assinem o protocolo de Kyoto.

Joint Scientific Academy Statement
Global Response to Climate Change

2005 (Glenaegle, Reino Unido) G8 + China, Índia e Brasil:

1. A mudança climática é real.
2. Como reduzir as causas da Mudança Climática (especialmente a emissão de CO_2).
3. Preparação para enfrentar as consequências da Mudança Climática.
4. Apelo aos líderes mundiais:

- ✓ reconhecer os riscos
- ✓ estudos internacionais para reduzir emissão dos gases
- ✓ mobilizar comunidade C&T
- ✓ desenvolvimento de fontes de energia limpa
- ✓ identificar os cursto-benefício das reduções
- ✓ auxiliar as nações em desenvolvimento nas medidas de C&T para o setor

Joint science academies' statement: Global response to climate change

Climate change is real

There will always be uncertainty in understanding a system as complex as the world's climate. However there is now strong evidence that significant global warming is occurring[1]. The evidence comes from direct measurements of rising surface air temperatures and subsurface ocean temperatures and from phenomena such as increases in average global sea levels, retreating glaciers, and changes to many physical and biological systems. It is likely that most of the warming in recent decades can be attributed to human activities (IPCC 2001)[2]. This warming has already led to changes in the Earth's climate.

The existence of greenhouse gases in the atmosphere is vital to life on Earth – in their absence average temperatures would be about 30 centigrade degrees lower than they are today. But human activities are now causing atmospheric concentrations of greenhouse gases – including carbon dioxide, methane, tropospheric ozone, and nitrous oxide – to rise well above pre-industrial levels. Carbon dioxide levels have increased from 280 ppm in 1750 to over 375 ppm today – higher than any previous levels that can be reliably measured (i.e. in the last 420,000 years). Increasing greenhouse gases are causing temperatures to rise; the Earth's surface warmed by approximately 0.6 centigrade degrees over the twentieth century. The Intergovernmental Panel on Climate Change (IPCC) projected that the average global surface temperatures will continue to increase to between 1.4 centigrade degrees and 5.8 centigrade degrees above 1990 levels, by 2100.

Reduce the causes of climate change

The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action. It is vital that all nations identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions.

Action taken now to reduce significantly the build-up of greenhouse gases in the atmosphere will lessen the potentially cost-effective technological options that could contribute to stabilising greenhouse gas concentrations. These are at various stages of research and development. However barriers to their broad deployment still need to be overcome.

Carbon dioxide can remain in the atmosphere for many decades. Even with possible lowered emission rates we will be experiencing the impacts of climate change throughout the 21st century and beyond. Failure to implement significant reductions in net greenhouse gas emissions now, will make the job much harder in the future.

Prepare for the consequences of climate change

Major parts of the climate system respond slowly to changes in greenhouse gas concentrations. Even if greenhouse gas emissions were stabilised instantly at today's levels, the climate would still continue to change as it adapts to the increased emission of recent decades. Further changes in climate are therefore unavoidable. Nations must prepare for them.

The projected changes in climate will have both beneficial and adverse effects at the regional level, for example on water resources, agriculture, natural ecosystems and human health. The larger and faster the changes in climate, the more likely it is that adverse effects will dominate. Increasing temperatures are likely to increase the frequency and severity of weather events such as heat waves and heavy rainfall. Increasing temperatures could lead to large-scale effects such as melting of large ice sheets (with major impacts on low-lying regions throughout the world). The IPCC estimates that the combined effects of ice melting and sea water expansion from ocean warming are projected to cause the global mean sea-level to rise by between 0.1 and 0.9 metres between 1990 and 2100. In Bangladesh alone, a 0.5 metre sea-level rise would place about 6 million people at risk from flooding.

greenhouse gases in the atmosphere will lessen the magnitude and rate of climate change. As the United Nations Framework Convention on Climate Change (UNFCCC) recognises, a lack of full scientific certainty about some aspects of climate change is not a reason for delaying an immediate response that will, at a reasonable cost, prevent dangerous anthropogenic interference with the climate system.

As nations and economies develop over the next 25 years, world primary energy demand is estimated to increase by almost 60%. Fossil fuels, which are responsible for the majority of carbon dioxide emissions produced by human activities, provide valuable resources for many nations and are projected to provide 85% of this demand (IEA 2004)[3]. Minimising the amount of this carbon dioxide reaching the atmosphere presents a huge challenge. There are many

Developing nations that lack the infrastructure or resources to respond to the impacts of climate change will be particularly affected. It is clear that many of the world's poorest people are likely to suffer the most from climate change. Long-term global efforts to create a more healthy, prosperous and sustainable world may be severely hindered by changes in the climate.

The task of devising and implementing strategies to adapt to the consequences of climate change will require worldwide collaborative inputs from a wide range of experts, including physical and natural scientists, engineers, social scientists, medical scientists, those in the humanities, business leaders and economists.

June 2005

Conclusion

We urge all nations, in the line with the UNFCCC principles[4], to take prompt action to reduce the causes of climate change, adapt to its impacts and ensure that the issue is included in all relevant national and international strategies. As national science academies, we commit to working with governments to help develop and implement the national and international response to the challenge of climate change.

G8 nations have been responsible for much of the past greenhouse gas emissions. As parties to the UNFCCC, G8 nations are committed to showing leadership in addressing climate change and assisting developing nations to meet the challenges of adaptation and mitigation.

We call on world leaders, including those meeting at the Gleneagles G8 Summit in July 2005, to:

- Acknowledge that the threat of climate change is clear and increasing.
- Launch an international study[5] to explore scientifically-informed targets for atmospheric greenhouse gas concentrations, and their associated emissions scenarios, that will enable nations to avoid impacts deemed unacceptable.
- Identify cost-effective steps that can be taken now to contribute to substantial and long-term reduction in net global greenhouse gas emissions. Recognise that delayed action will increase the risk of adverse environmental effects and will likely incur a greater cost.
- Work with developing nations to build a scientific and technological capacity best suited to their circumstances, enabling them to develop innovative solutions to mitigate and adapt to the adverse effects of climate change, while explicitly recognising their legitimate development rights.
- Show leadership in developing and deploying clean energy technologies and approaches to energy efficiency, and share this knowledge with all other nations.
- Mobilise the science and technology community to enhance research and development efforts, which can better inform climate change decisions.

Notes and references

1 This statement concentrates on climate change associated with global warming. We use the UNFCCC definition of climate change, which is 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'.

2 IPCC (2001). Third Assessment Report. We recognise the international scientific consensus of the Intergovernmental Panel on Climate Change (IPCC).

3 IEA (2004). World Energy Outlook 4. Although long-term projections of future world energy demand and supply are highly uncertain, the World Energy Outlook produced by the International Energy Agency (IEA) is a useful source of information about possible future energy scenarios.

4 With special emphasis on the first principle of the UNFCCC, which states: 'The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof'.

5 Recognising and building on the IPCC's ongoing work on emission scenarios.

Academia Brasiliera de Ciências
Brazil

Royal Society of Canada,
Canada

Chinese Academy of Sciences,
China

Académie des Sciences,

Deutsche Akademie der Naturforscher

Indian National Science Academy,

Accademia Nazionale dei Lincei,
Italy

Science Council of Japan,
Japan

Russian Academy of Sciences,
Russia

Royal Society,
United Kingdom

National Academy of Sciences,
United States of America

Academies of Science of G8 (Canada, France, Germany, Italy, Japan, Russia, UK, USA) and Academies of Brazil, China, India and South Africa. Moscow, May/2006

Joint Science Academies Statement
Energy, Sustainability and Security

2006 (São Petersburgo, Rússia) G8 + China, Índia, Brasil e África do Sul:

1. Enfatiza os três componentes do desenvolvimento sustentável: prosperidade econômica, desenvolvimento social e proteção ambiental e que o suprimento sustentável de energia é condição essencial para satisfazer os três objetivos.
2. Os dois primeiros tópicos tratam dos desafios e soluções para alcançar fornecimento sustentável de energia.
3. O terceiro tópico trata das necessidades de CT&I para o setor:

- ✓ melhorar eficiência energética
- ✓ diversificar estratégias
- ✓ desenvolver sistemas limpos para uso do carvão
- ✓ criar sistemas nucleares avançados e seguros
- ✓ controle da poluição
- ✓ produção e conversão de biomassas
- ✓ fontes renováveis de energia de longo termo (ventos, geotérmico, solar etc)
- ✓ pequenos sistemas decentralizados para atender áreas rurais e pobres

Joint Science Academies' Statement: Energy Sustainability and Security

Broad international consensus recognizes three principal, inter-related components of sustainable development: economic prosperity, social development, and environmental protection. Sustainable and reliable supply of energy is one of the major conditions for achieving these three goals, for all countries of the world: if energy sustainability and security fail, the primary human development goals cannot be achieved.

Last year we addressed the major challenges of climate change. These challenges are predominantly related to energy systems and use. We therefore welcome the opportunity to address energy sustainability and security on the occasion of the 2006 G8 Summit — and we expect to continue our focus on these critical issues in future years. The InterAcademy Council, established by the Academies of the world, is now engaged in an in-depth examination of this energy technology transition challenge, to be completed within a year.

Problems and Challenges of Energy Sustainability and Security

It has become increasingly clear that there are very serious difficulties related to sustainability and security of energy. These include:

- Major global and regional impacts on the environment, climate change and health from an extrapolation of current energy sources and systems
- A clear projection that demand for affordable and clean energy sources will increasingly grow, requiring investments to create an efficient system of global energy supply
- Tensions, especially in energy supplies for transport systems
- Increasingly poor geographical correlations between energy sources and users

be necessary to develop and deploy new sources and systems for energy supply, including clean use of coal and unconventional fossil resources, advanced nuclear systems, and renewable energy. Diversification of engine fuels, increased use of low-emissions technologies in personal transport, and a greater emphasis on deployment of urban mass transit would introduce much-needed flexibility and economy in a rapidly urbanizing world.

The necessary changes and transitions in energy systems and paradigms will not be possible without achievement of many challenging scientific, technical and economic objectives, and will require the investment of enormous resources in a sustained way over decades. They will also require major openness and transfer of knowledge, technology and capital.

Achieving an acceptable level of global energy sustainability and security will therefore require sustained governmental focus and international cooperation on identifying strategic energy policy priorities, and the sustained implementation of corresponding policies, actions, and national investments. It will also be critical to involve the public and industry leadership in setting and achieving the key priorities, if we are to collectively deal with threats to energy sustainability and security in time to avoid major economic, environmental, and political damage.

The common strategic priorities should include:

- Promotion of energy efficiency, including improving the energy efficiency and economic effectiveness of the energy system in a holistic way
- Diversification of energy supply and demand, as diversity of energy mix, sources, markets, transportation routes and means of transportation decrease vulnerability related to single or predominant sources and systems
- Development of global energy infrastructure with attention to its resilience

- Inefficient and wasteful use of energy resources
- Sharply rising and fluctuating oil and gas prices
- Providing fuels and electricity to a significant portion of the world's population to help improve their quality of life
- Impacts of natural disasters, systems breakdowns, and human acts on energy infrastructure

Resolving Energy Sustainability and Security Challenges

Providing for global energy sustainability and security will require many vigorous actions at national levels, and considerable international cooperation. These actions and cooperative steps will need to be based on wide-spread public support, especially in exploring avenues for increased efficiency of energy use. Secondly, it will

note of the areas in which international cooperation, substantial research and development, and innovation, will be critical. Important examples of such areas are:

- Energy efficiency for buildings, devices, motors, transportation systems and in the energy sector itself, which has a great capacity for boosting energy efficiency
- Systems analysis to find efficient strategies for various conditions
- Clean coal systems, including potential for sequestering of CO_2
- Advanced nuclear systems, addressing the problems of safety, waste, and non-proliferation
- Pollution control
- Unconventional fossil fuels and related environmental protection
- Biomass production and conversion, gas-to-liquid conversion
- Renewable energy sources for the long-term, such as geothermal, wind, tidal and solar, and energy storage technologies
- Promotion of clean and affordable energy sources and systems, including advanced nuclear technologies and renewable systems
- Decentralization of energy production through development of local energy resources and systems
- Promotion of cost-effective economic instruments that can help to reduce the emission of greenhouse gases
- Addressing the urgent human needs of approximately a third of the world population which does not have access to modern energy

Innovation, Research, Development and Deployment

We recognize the special responsibility of the science and engineering community to help implement transitions to sustainable and secure energy systems. We take special

leading role in assuring global energy sustainability and security.

We call on world leaders, especially those meeting at the G8 Summit in July 2006, to:

- Articulate the reality and urgency of global energy security concerns
- Plan for the massive infrastructure investments, and lead times required for a transition to clean, affordable and sustainable energy systems
- Intensify cooperation with developing countries to build their domestic capacities to use existing and innovative energy systems and technologies, including transfer of technologies
- Promote by appropriate policies and economic instruments the development and implementation of cost-competitive, environmentally beneficial, and market acceptable clean fossil, nuclear, and renewable technologies
- Ensure, in cooperation with industry, that technologies are developed and implemented and actions taken to protect energy infrastructures from natural disasters, technological failures, and human actions

- Small decentralized systems addressing needs of poor, rural, and isolated systems, and examination of wider application of such systems

Conclusions

We call on all countries of the world to cooperate in identifying common strategic priorities for sustainable and secure energy systems, and in implementing actions toward those strategic priorities.

G8 countries bear a special responsibility for the current high level of energy consumption, and should play a

- Address the serious inadequacy of R&D funding and provide incentives to accelerate advanced energy-related R&D, also in partnership with private companies
- Implement education programs to increase public understanding of energy challenges, and to provide for energy-related expertise and engineering capabilities
- Focus governmental research and technology efforts on energy efficiency, non-conventional hydrocarbons and clean coal with CO_2 sequestration, innovative nuclear power, distributed power systems, renewable energy sources, biomass production, biomass and gas conversion for fuels.

Academia Brasileira de Ciéncias, Brazil

Royal Society of Canada, Canada

Chinese Academy of Sciences, China

Académie des Sciences, France

Deutsche Akademie der Naturforscher Leopoldina, Germany

Indian National Science Academy, India

Accademia Nazionale dei Lincei, Italy

Science Council of Japan, Japan

Russian Academy of Sciences, Russia

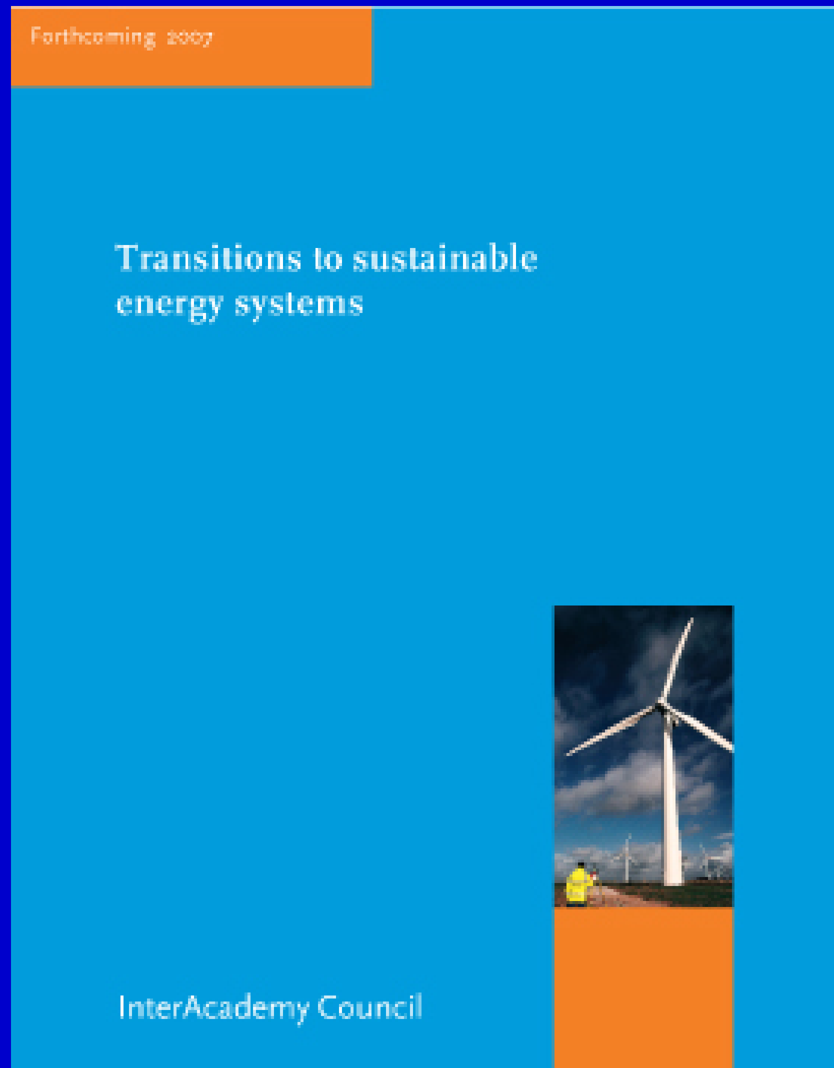
Academy of Science of South Africa, South Africa

Royal Society, United Kingdom

National Academy of Sciences, United States of America

Academies of Science of G8 (Canada, France, Germany, Italy, Japan, Russia, UK, USA), Brazil, China, India and South Africa with chanceler Angela Merkel. Berlin, May/2007

InterAcademy Council



Forthcoming IAC Report, Spring 2007

InterAcademy Council

Panel Co-Chairs José Goldemberg and Steven Chu confer with members of IAC study panel on Transitions to Sustainable Energy Systems. Amsterdam, June 2006.

InterAcademy Council

Transitions to Sustainable Energy

Co-Chairs:

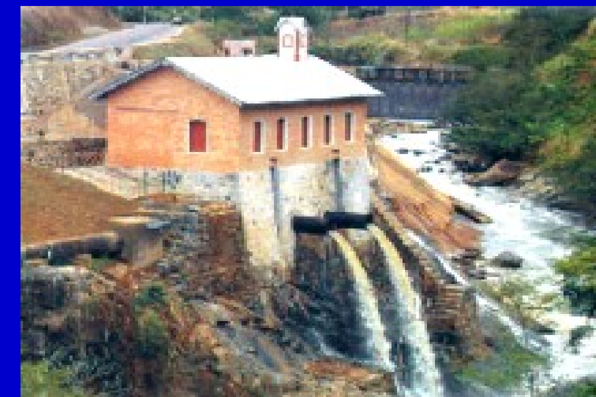
Steven CHU - USA
José GOLDEMBERG – Brazil

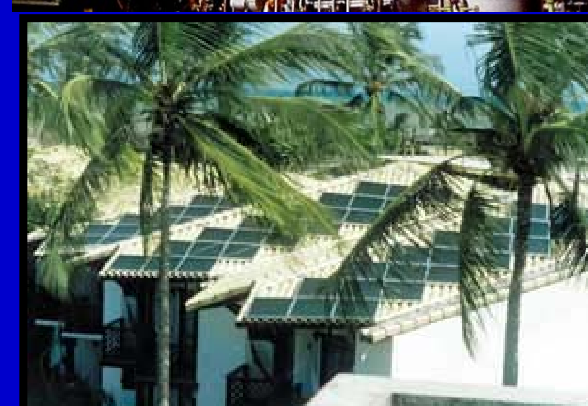
Members:

Shem ARUNGU OLENDE - Kenya
Ged DAVIS - UK
Mohamed EL-ASHRY - Egypt
Thomas JOHANSSON - Sweden
David KEITH - Canada
LI Jinghai - China
Nebosja NAKICENOVIC - Austria
Rajendra PACHAURI - India
Majid SHAFIE-POUR - Iran
Evald SHPILRAIN - Russia
Robert SOCOLOW -USA
Kenji YAMAJI - Japan
YAN Luguang - China

Brazil

Sustainable Energy





Marcelo Poppe

CGEE

Center for Strategic Management and Studies

Brazil

Financial Resources

Innovative projects support instruments

- PNDCT - Sectorial Founds (Federal Agencies)
- State Agencies for research support
- Public own entreprises and organisations – Petrobras (Cenpes), Eletrobrás (Cepel, ELN, Chesf), Embrapa, Ibama, etc.
- Private Class Entities – CNI, CNA, etc.
- Aneel / Utilities R&D and EE Investments
- Development Banks and Agencies Programs (Finep, BNDES, BNB, BB, etc.)

Brazil
Industry commitment

Sustainable Energy Program

Competitive power supply for sustainable industrial development

Energy Conservation Innovative processes and technologies	**Modalities of intervention** Studies Motivation Capacity building Information Technical assistance
Quality and Efficiency of Equipments G, T & D and consuming, metrology	
Rational Use of Energy Self generation, social and environmental responsibilities, climate change	**Main instruments** R & D and innovation agenda Public policies recommendations

Brazil

MCT action plan 2007-2010

Science, Technology and Innovation for National Development

III - R, D & I in Strategic Areas

7. Biotechnology and Nanotechnology
8. Information and Communication Technologies
10. Biofuels
11. Electricity, hydrogen e renewable energy
12. Oil, natural gas and coal
13. Agribusiness

Brazil

Bioethanol R&D&I priorities

- Conventional genetic improvement and genetic engineering
- Production models and infrastructure
- Biotechnologies, agriculture of precision and optimization of inputs
- Mechanical harvest, without burning and with straw collecting
- Pre-processing and stock of bagasse and straw
- Fermentation, grinding and distillation improvements
- Management and automation (advanced system)
- Reduction of water and energy consumption and recycle of effluents
- Increase of the excess power generation
- Alcohol-chemistry, sugar-chemistry and biorefinery
- Hydrolysis and gasification (F-T) of bagasse and straw
- Sugar-cane of high biomass - "energy cane"

Perspectivas da Pesquisa e Desenvolvimento

Marcelo Khaled Poppe

Centro de Gestão e Estudos Estratégicos

Maio de 2007

Parte I
Negociações internacionais

Convenção do Clima

- Responsabilidades comuns porém diferenciadas
- Adaptação e mitigação
- **Protocolo de Quioto**: metas de redução de emissões para países industrializados em 2008-2012 (1ª rodada)
- Mecanismo de Desenvolvimento Limpo – **MDL**

  redução de emissões

  seqüestro de carbono

  desenvolvimento sustentável
- Diálogos Pós Quioto (2ª rodada, outros regimes**)**

- **Especialistas:** André Aranha Correa do Lago

  Luiz Gylvan Meira Filho

  André Santos Pereira

  Emilio Lèbre La Rovere

Parte II
Vulnerabilidade, impactos e adaptação

Zonas costeiras

- Energia e recursos hídricos
- Florestas, agropecuária e solos
- Semi-árido
- Biodiversidade
- Saúde

- **Especialistas:** Carlos A. Nobre, Claudio Freitas Neves, Dieter Muehe, Marcos Freitas, Thelma Krug, Enéas Salati, Magda Aparecida de Lima, José A. Marengo, Vanderlei Perez Canho, Ulisses E. C. Confalonieri

Parte III A
Mercado Internacional de carbono

- O advento do mercado de carbono
- A formação do mercado de créditos de carbono
  - Estrutura do mercado
  - Transações via projetos
  - Permissão de emissões
  - Outros mercados
- Os fundos de financiamento do mercado
- As perspectivas do mercado de carbono

- **Especialistas:** Carolina Burle S. Dubeux
  André Felipe Simões
  Roberto Schaeffer
  Marcelo Khaled Poppe

Parte III B
Oportunidades de negócios MDL para o Brasil

- Biocombustíveis: etanol e biodiesel
- Biogás de aterro sanitário e redução de metano
- Energias renováveis nos sistemas isolados
- Energias renováveis no sistema interligado
- Eficiência energética
- Florestamento e reflorestamento

- **Especialistas:** Claudia do Vale Costa
  Emilio Lèbre La Rovere
  Carolina Dubeux
  Luiz Edmundo C. Leite
  Cláudio Fernando Mahler
  Luciano Basto Oliveira
  Magda Aparecida de Lima
  Enéas Salati
  Thelma Krug
  Carlos Nobre

Políticas públicas
para viabilização das oportunidades

- Instrumentos legais e regulamentares
- Incentivos econômico-financeiros
- Conhecimento, ciência, tecnologia, inovação
- Estrutura eficiente para fluxo de projetos MDL
  informação, capacitação, assistência técnica

- Especialistas: Manoel F. M. Nogueira, Fernando Rei, Marcelo Khaled Poppe, Mauricio Mendonça, Kamyla B. da Cunha, Marcelo Theoto Rocha portal

inovação

www.portalinovacao.mct.gov.br

Serviço de governo eletrônico para promoção da inovação e do aumento da competitividade da economia brasileira, por meio da interação e da cooperação tecnológica entre empresas e comunidade tecnico-científica

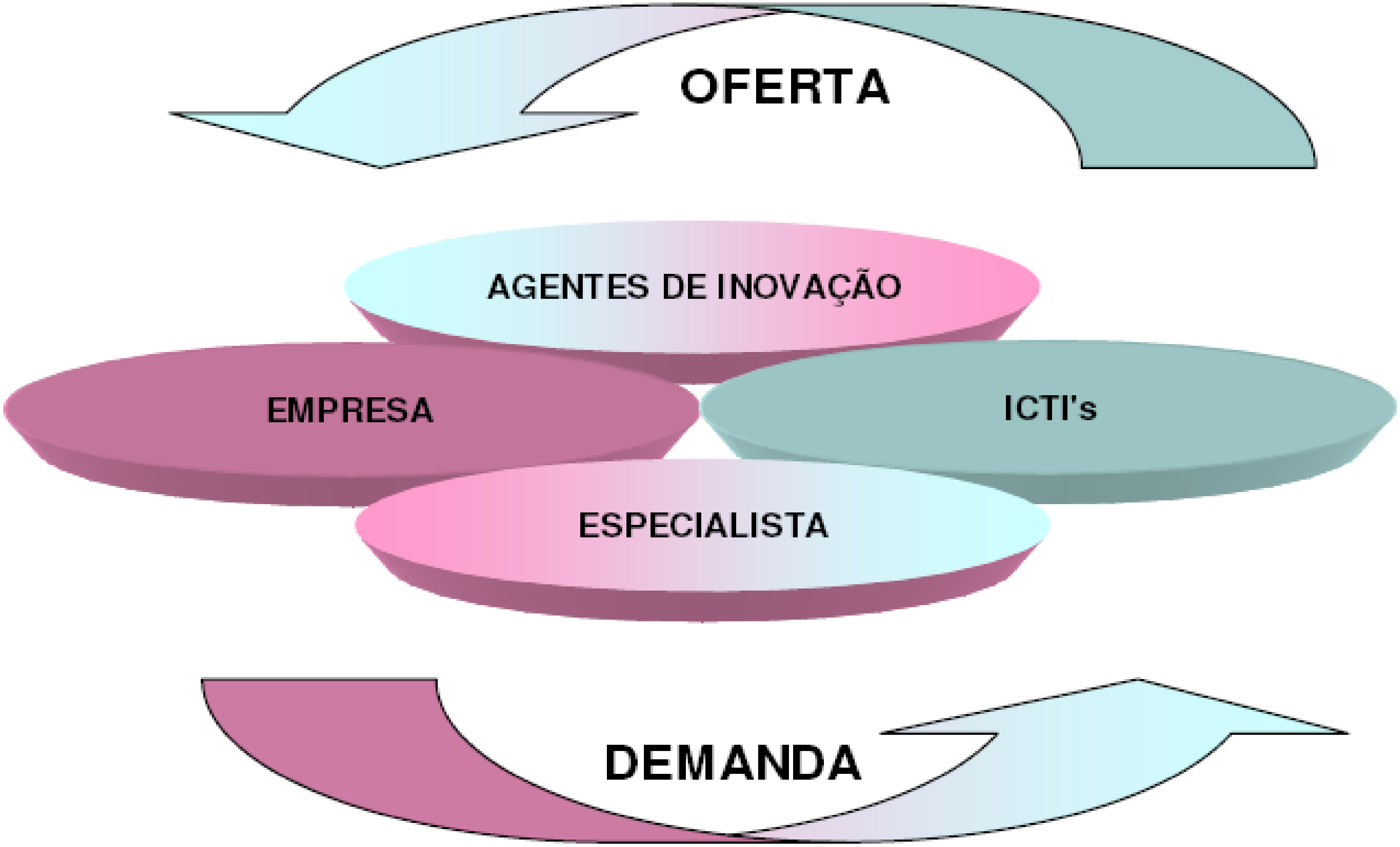
FIESP, maio de 2008

Objetivos do Portal Inovação

- **Mapeamento de competências e ofertas**, permitindo que empresários e demais atores de inovação conheçam as competências tecnológicas nacionais disponíveis;
- **Mapeamento das demandas de empresas** e dos demais atores de inovação que podem ser gênese de cooperação voltada à inovação;
- **Interação** entre a oferta de conhecimento técnico-científico e sua demanda pelo setor empresarial;
- **Apoio à gestão da inovação** por meio de sistemas de informação e de conhecimento e da sua integração com outras iniciativas em inovação.
- **Divulgação de instrumentos** de apoio à inovação para todos os atores do sistema, em cooperação com outras iniciativas.

Visão Geral: Atores e Informações do Portal Inovação

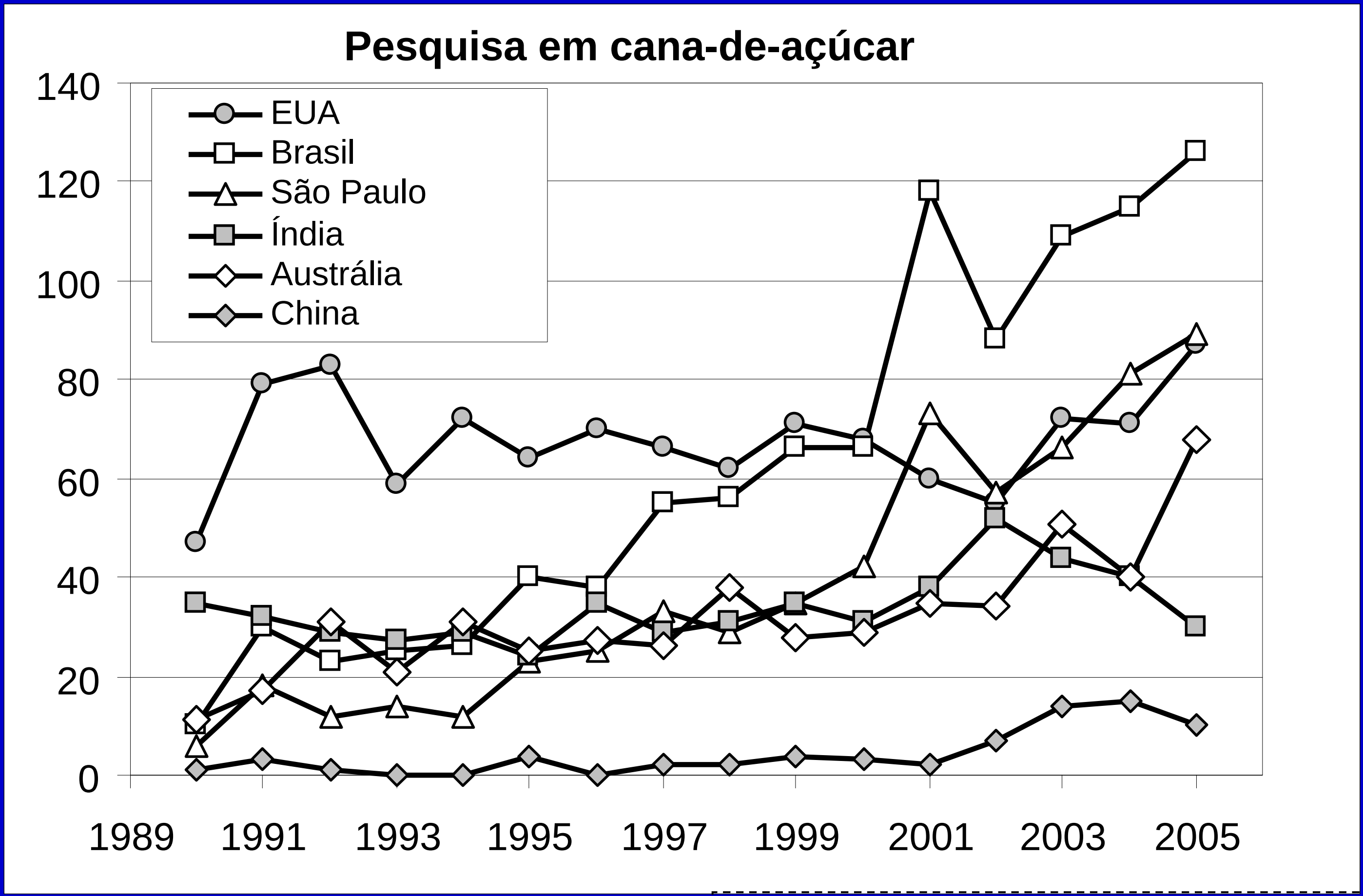
Atores do Sistema Nacional de Inovação têm ambientes específicos no Portal Inovação



Brazil

Scientific and technological base

Scientific publications related with the sugar-cane



Source: ISI – Web of Science (29/09/2006).

Estratégia de busca: (TS=(sugarcane or "sugar cane" or Sacchacarum) or TI=(sugarcane or "sugar cane" or Sacchacarum)) NOT TS=(alcoholism or psychiatr* or clinic or medicin*).

Biotechnology for Biofuels

BioMed Central

Review

Open Access

The Brazilian biofuels industry

José Goldemberg

Address: University of São Paulo, Institute of Electrotechnics and Energy, Av. Prof. Luciano Gualberto, São Paulo, SP 05508-010, Brazil

Email: José Goldemberg - goldemb@iee.usp.br

Published: 1 May 2008

Received: 12 March 2008
Accepted: 1 May 2008

Biotechnology for Biofuels 2008, 1:6 doi:10.1186/1754-6834-1-6

This article is available from: http://www.biotechnologyforbiofuels.com/content/1/1/6

Abstract

Ethanol is a biofuel that is used as a replacement for approximately 3% of the fossil-based gasoline consumed in the world today. Most of this biofuel is produced from sugarcane in Brazil and corn in the United States. We present here the rationale for the ethanol program in Brazil, its present 'status' and its perspectives. The environmental benefits of the program, particularly the contribution of ethanol to reducing the emission of greenhouse gases, are discussed, as well as the limitations to its expansion.

Introduction

Fuel-grade ethanol, produced from biomass, has been considered as a suitable automotive fuel for nearly a century, particularly for vehicles equipped with spark-ignition engines (technically referred to as Otto cycle engines, but commonly known as gasoline engines). Ethanol was not used in significant amounts until the mid 1970s. The dramatic increase in the cost of oil at the time of the first oil crisis imposed severe foreign exchange burdens on countries dependent upon oil imports, including Brazil. As a leading producer of sugar from sugarcane, Brazil was well situated to explore the option of ethanol as an alternative to gasoline. This led the Government to encourage the redirection of some sugarcane production to generate ethanol as a replacement for gasoline, thus reducing oil imports.

Under the Brazilian Government's plan, PETROBRAS, the state-owned oil company, would purchase a guaranteed amount of ethanol from producers. In addition, economic incentives were given to agro-industrial enterprises willing to produce ethanol, in the form of low interest rates. This translated into nearly US$2.0 billion in loans from 1980 to 1985, representing 29% of the total investment needed [1]. On the basis of such policies, ethanol production increased rapidly over the years, reaching 18 billion liters in 2007.

Ethanol from sugarcane, produced under proper conditions, is essentially a renewable fuel and has clear advantages over gasoline in reducing greenhouse gas emissions and improving air quality in metropolitan areas.

In this paper we review the technological characteristics of ethanol as a fuel, the present 'status' of the ethanol Program in Brazil, the characteristics of ethanol as a renewable fuel, the future perspectives of the ethanol Program in Brazil followed by a discussion on the possibility of expanding ethanol production from sugarcane and conclusions.

Technical characteristics of ethanol as a fuel

Ethanol is an excellent motor fuel. It has a motor octane number of 98 which exceeds that of gasoline (octane number of 80). It also has a lower vapor pressure than gasoline, which results in lower evaporative emissions. Ethanol's flammability in air is also lower than that of gasoline which reduces the number and severity of vehicle fires. Anhydrous ethanol has lower and higher heating