

Ministry of
Mines and Energy



THE HYDROGEN ECONOMY DEVELOPMENT IN BRAZIL

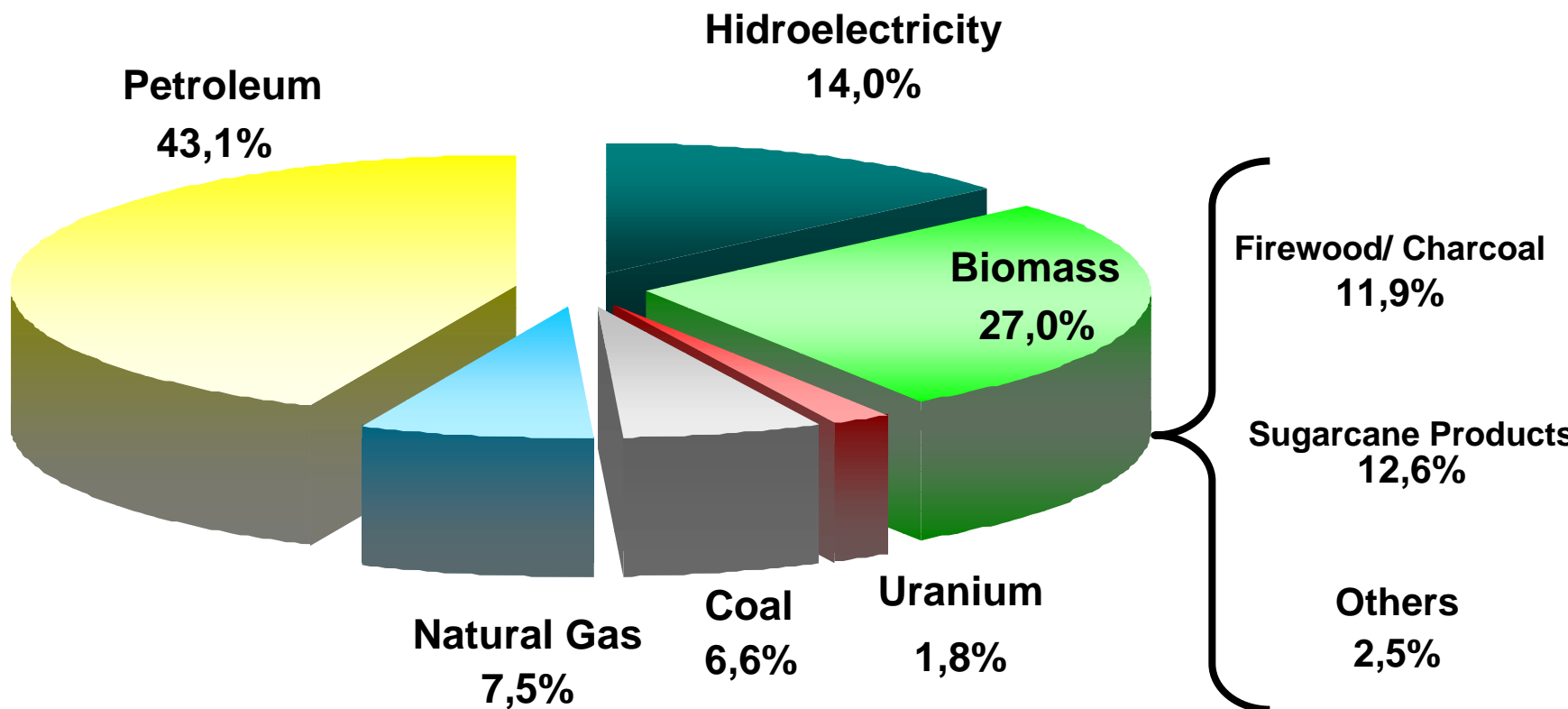
Road Map - 1st version

March 22th. 2005

Secretary of Petroleum, Natural Gas and Renewable Fuels



BRAZILIAN ENERGY MATRIX





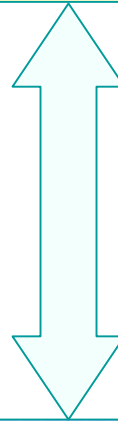
PETROLEUM & NATURAL GAS IN BRAZIL

petroleum

- Proven Reserves = 10,6 billion barrels
- Production (oct 2004) = 1,53 million barrels /day
- Consumption (oct 2004) = 1,71 million barrels /day
- Production Target (2005) = 1,62 million barrels /day
- Relation Reserve/Production - R/P = 18 years

Sediment Basins:
6,4 million km²

Concession Area = 140 000 Km²
(40 companies)



natural gas

- Proven Reserves : 245,3 billion m³ (8,4 tcf)
- National Natural Gas Production: 46,3 million m³/day
- Comercialized Natural Gas: 41,4 million m³/day
- Imports: 21,9 million m³/day



BRAZILIAN ENERGY MATRIX

Hidro - 72.678 MW

Gas - 6.362 MW

Petro - 5.845 MW

Coal - 1.461 MW

Nuclear - 2007 MW

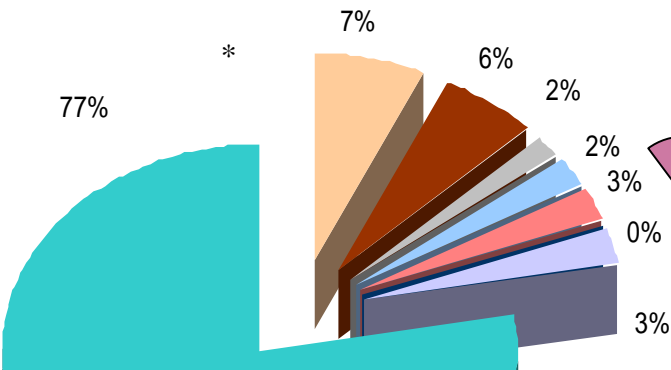
Biomass - 2.448 MW

Wind - 22 MW

Imports - 2.500 MW

Soi

* - includes Paraguayan S



Black Liquor

Rice Husk

Sugarcane Bagasse

Sawdust

Biogas

Charcoal

70,8%

1.934 MW

24%

4,2%

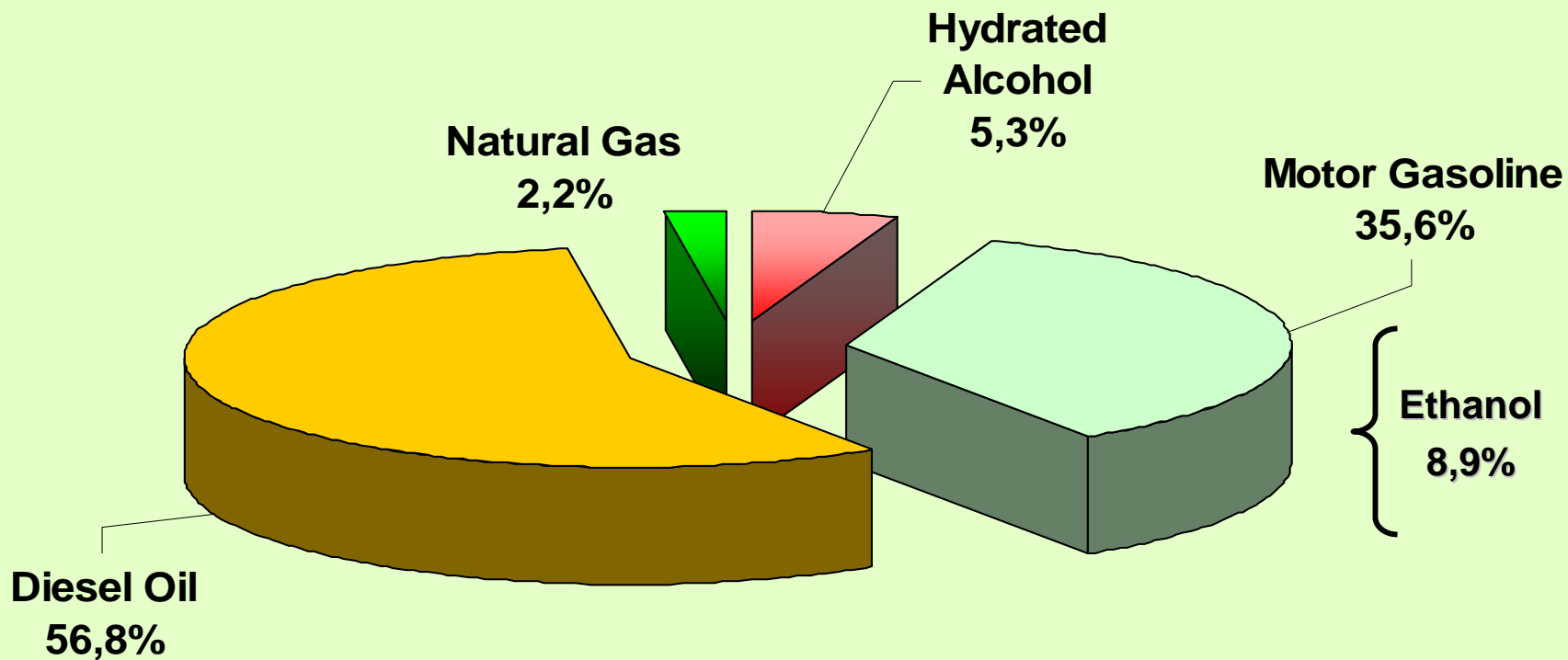
0,7%

0,2%



Alcohol in Energy Supply – Transports

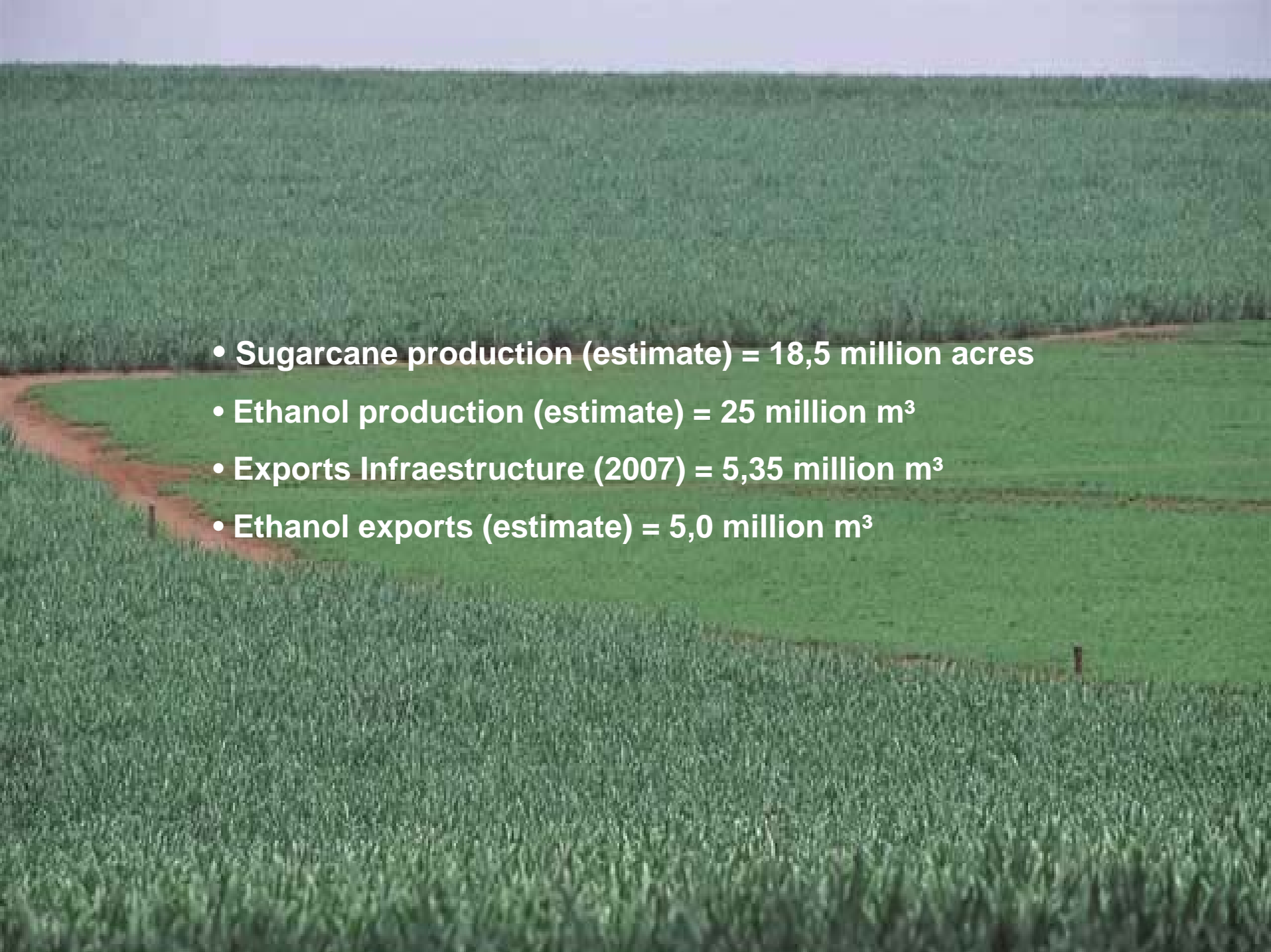
2004





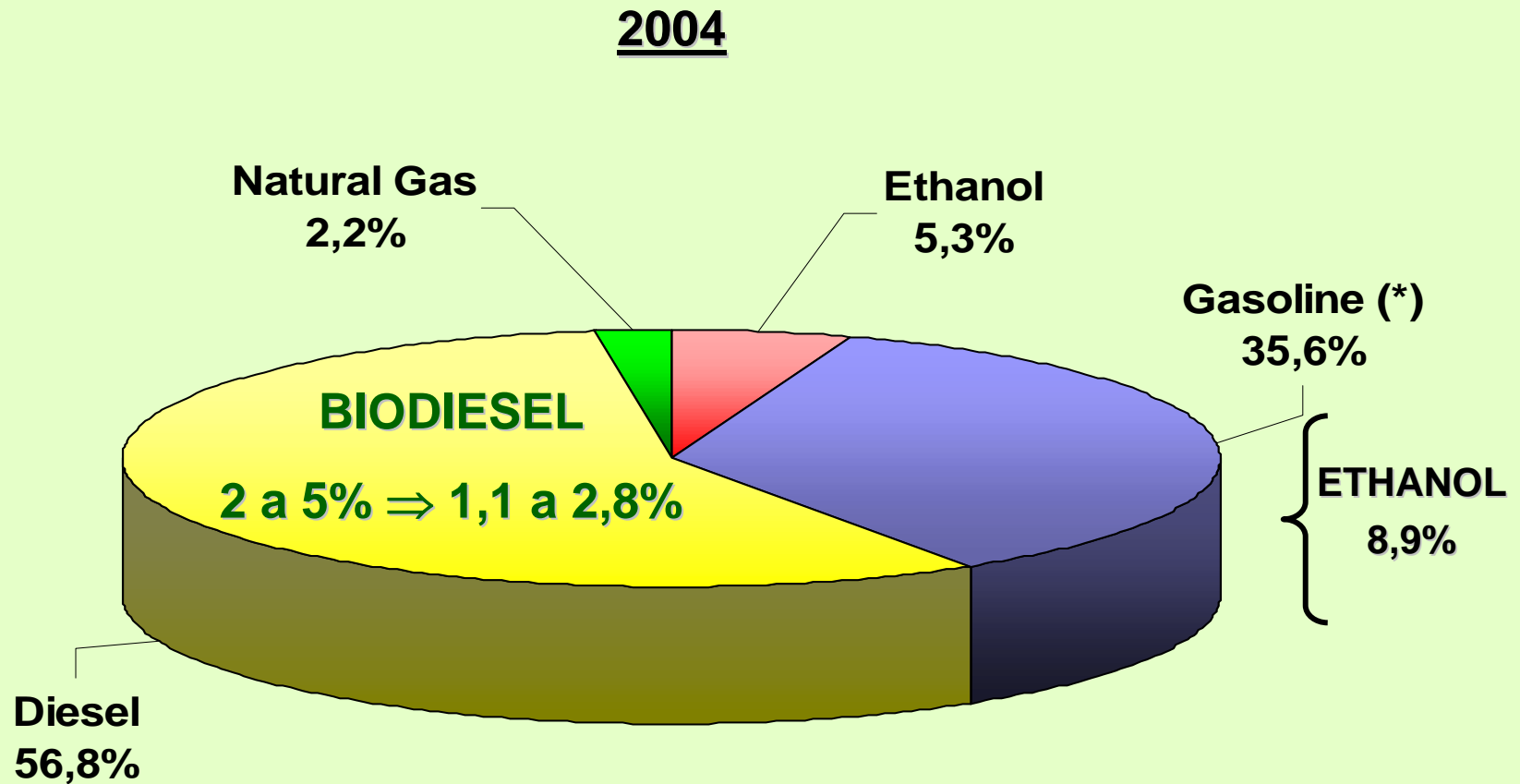
Alcohol Industry in Brazil - 2005

- Biggest sugar cane producer = 13,3 million acres
- Harvested area (Ethanol) = ~ 6,7 million acres
- Biggest Ethanol Producer = 14,6 million m³
- Biggest Ethanol Consumer = 12,2 million m³
- Ethanol Exports (2004) = 2,38 million m³
- Production Capacity for Ethanol Production = 17 million m³
- Exports Infraestructure - 2004 = 3,67 million m³

- 
- Sugarcane production (estimate) = 18,5 million acres
 - Ethanol production (estimate) = 25 million m³
 - Exports Infrastructure (2007) = 5,35 million m³
 - Ethanol exports (estimate) = 5,0 million m³

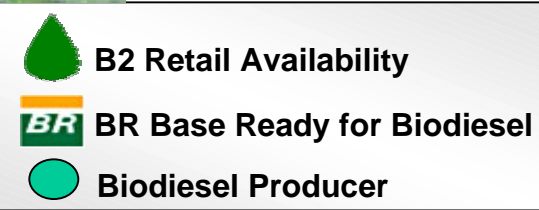


Biodiesel in Energy Supply – Transports



(*) All gasoline commercialized in Brazil has 25% of ethanol.

BIODIESEL: THE NEW FUEL FROM BRAZIL



Soybean – Castor-Bean-
Cotton-Seed



Soybean - Cotton-Seed
Sun-flower



Babassu – Castor-Bean
Palm – Cotton-Seed



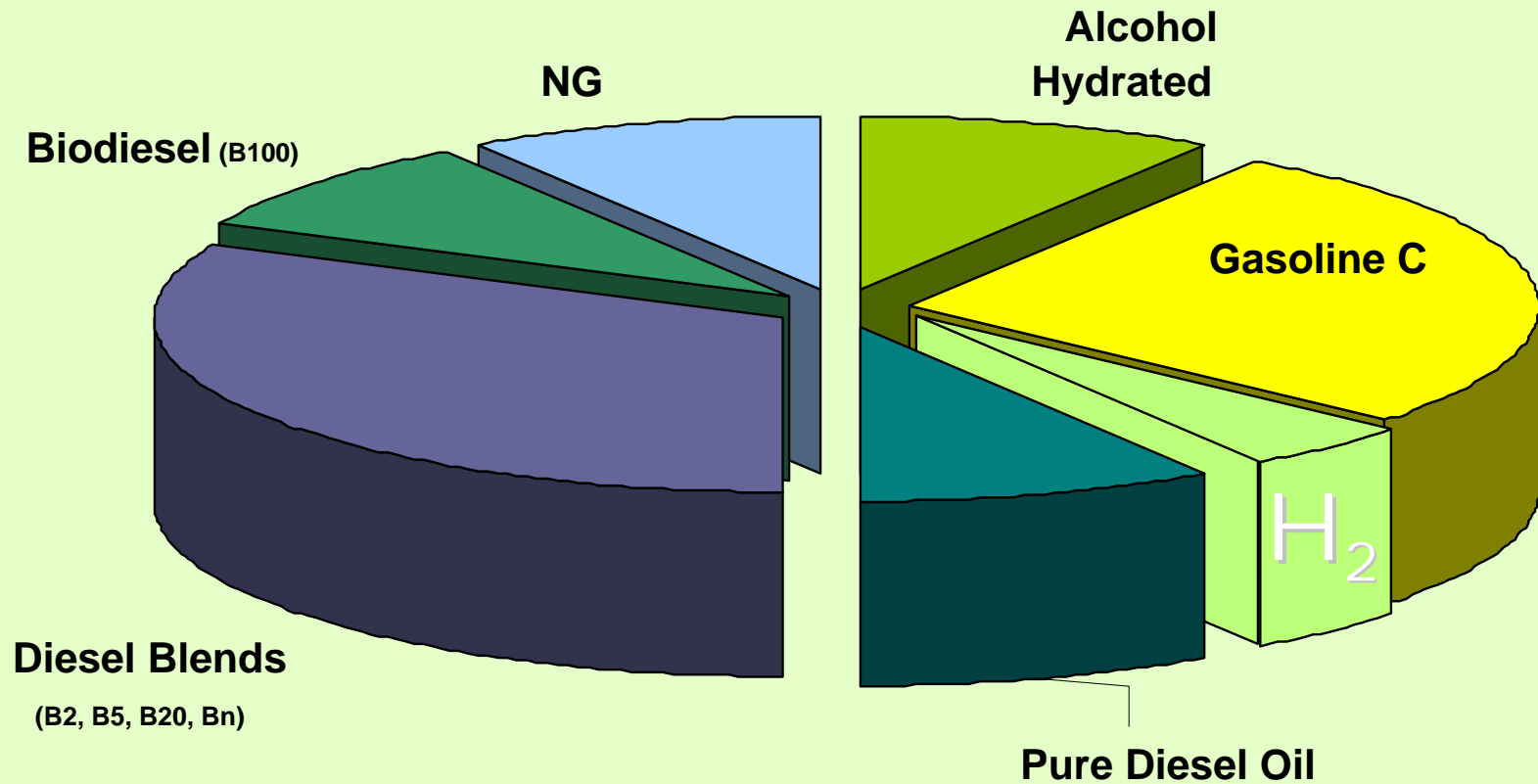
Soybean - Cotton-Seed
Sun-flower



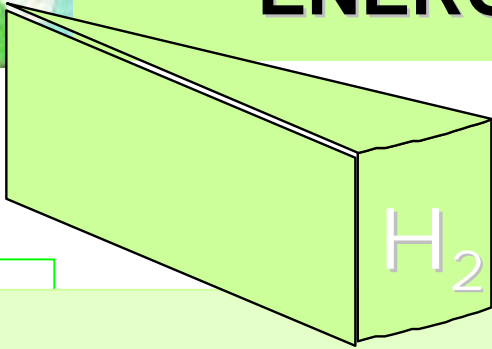


.. H2 as a complement to the already renewable Brazilian energy matrix

exercise



ENERGETIC HYDROGEN USE IN BRAZIL



OBJECTIVE

To plan and develop the actions that may lead to the Hydrogen use by 2020 as a complement to the already renewable Brazilian energy matrix.

PERMANENT ACTIVITY

**COURSES OF ACTION FOR THE DRAW OF BRAZILIAN
POLICY: THE USE OF HYDROGEN ENERGY VECTOR**

TODAY STAGE

BRAZILIAN HYDROGEN ROAD MAP – BETA VERSION

ENERGY MATRIX: POLICY AND COURSES OF ACTION

H₂

- SOCIAL INCLUSION
- ENVIRONMENT CONCERN
- FOSSIL FUELS REDUCTION – MAJOR USE OF RENEWABLE FUELS
 - TECHNOLOGICAL BASIS STRENGTHTEN
- NATIONAL GOODS AND SERVICES INDUSTRY DEVELOPMENT



BRAZILIAN HYDROGEN ECONOMY DEVELOPMENT



Phase #1: The roadmap construction - beta version - 2004 a 2005;
The establishment of global milestones

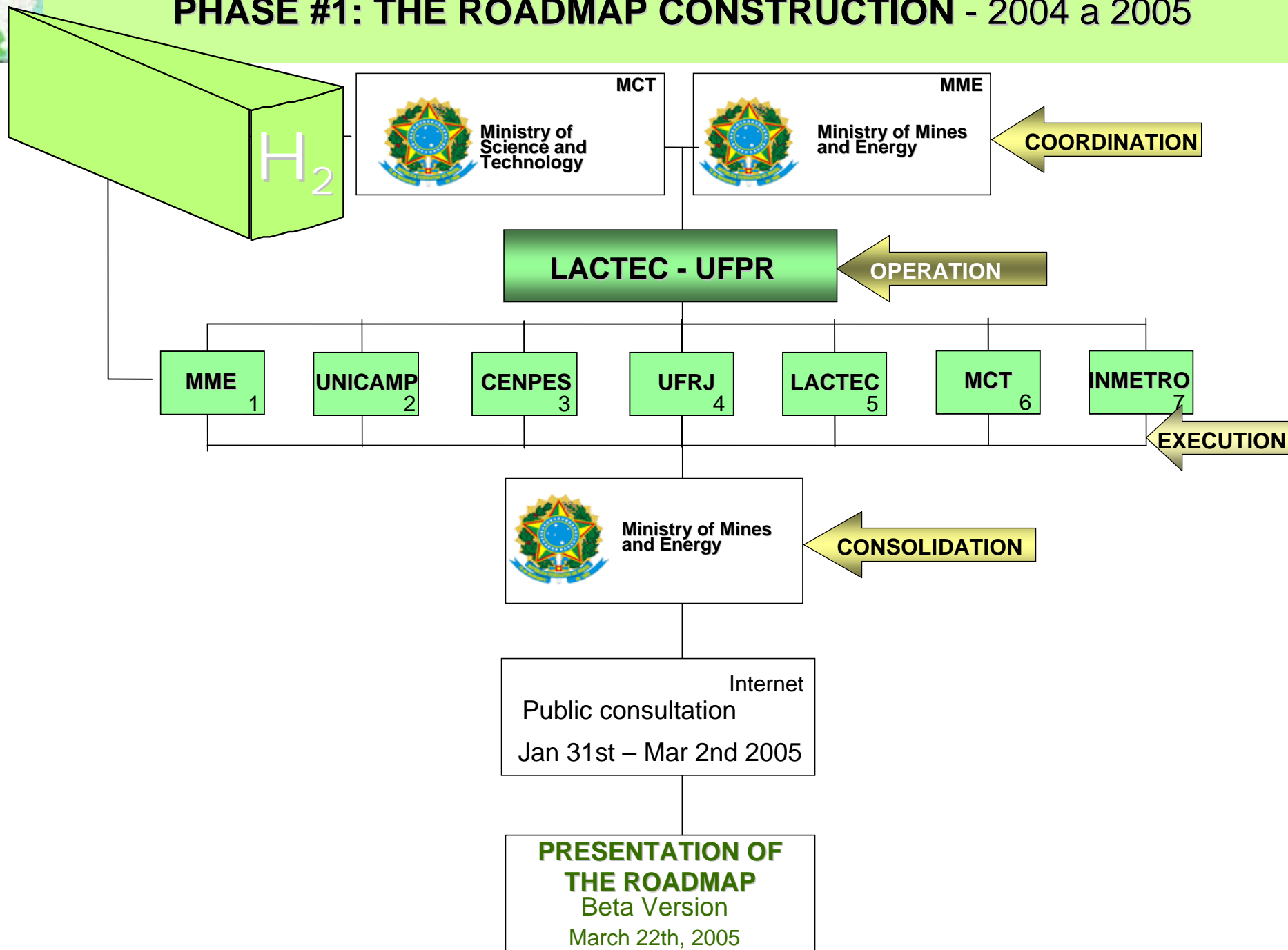
Phase #2: The organization and development of estructural projects
2005 a 2006
Global milestones/ Goals description

Phase # 3: Roadmap revision – Version I - 2005 / 2006 / 2007;

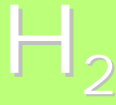
Phase # 4: Making of the Governmental Program for Production and
Use of Hydrogen in Brazil – 2007;

Phase # 5: The implementation of activities towards the establishment
of an hydrogen economy in Brazil – 2007 a 2025.

PHASE #1: THE ROADMAP CONSTRUCTION - 2004 a 2005



PHASE #1: THE ROADMAP CONSTRUCTION - 2004 a 2005

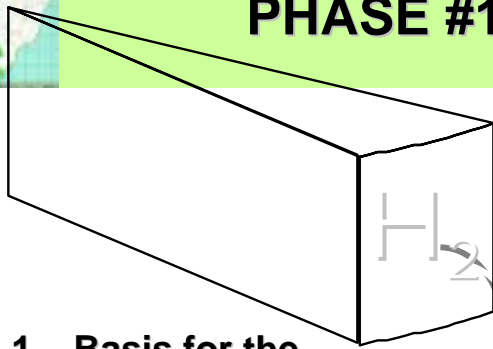


- 1 – Basis for the Development of a Hydrogen Market
- 2 – Production of Hydrogen
- 3 – Logistics: Storage, Transport and Distribution
- 4 – Conversion Systems
- 5 – Applications: Hydrogen as an Energy Vector
- 6 – Technological and Human Resources Development
- 7 – Metrology, Standardization, Conformity Evaluation, Regulation and Fiscalization

➤ The ETHANOL is the main source of hydrogen production in Brazil, considering the Brazilian expertise on technologies of sugarcane growing, production of alcohol fuel, distribution and its uses.

➤ The ethanol reform to hydrogen and its direct use on fuel cell DEFC type – Direct Ethanol Fuel Cell – are presented as technologies that must be developed with highest priority.

PHASE #1: THE ROADMAP CONSTRUCTION - 2004 a 2005

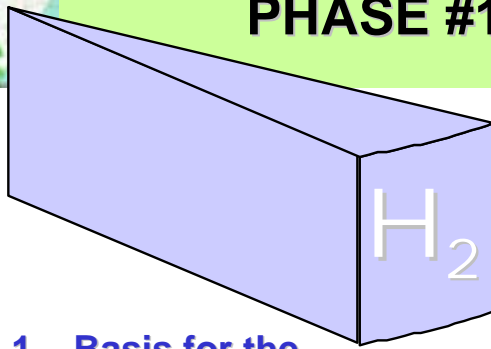


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➤ **Water electrolysis will be highly spread in hydrogen production since more than 70% of installed capacity of electric generation comes from hydroelectricity.**

➤ **In order to make the ELECTROLYTIC HYDROGEN competitive, a strong effort on developing systems of conventional and advanced electrolysis is necessary.**

PHASE #1: THE ROADMAP CONSTRUCTION - 2004 a 2005



1 – Basis for the Development of a Hydrogen Market

2 – Production of Hydrogen

3 – Logistics: Storage, Transport and Distribution

4 – Conversion Systems

5 – Applications: Hydrogen as an Energy Vector

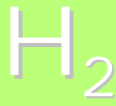
6 – Technological and Human Resources Development

7 – Metrology, Standardization, Conformity Evaluation, Regulation and Fiscalization

➤ **NATURAL GAS will be the mostly used source in the first 15 years of hydrogen production.**

➤ **Brazil will be dedicated to optimize the systems that deals with natural gas reform to accelerate its position on hydrogen market.**

PHASE #1: THE ROADMAP CONSTRUCTION - 2004 a 2005

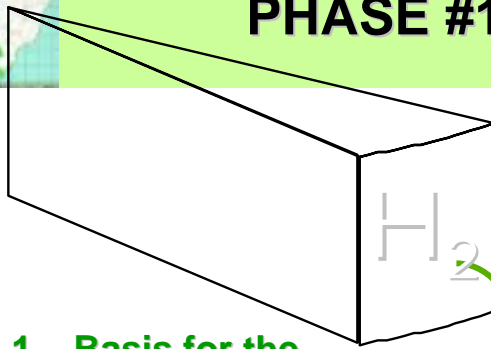


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➤ Biomass, biogas and ethanol will put Brazil in a condition of the biggest producer of renewable hydrogen.

➤ Brazil must seek world leadership on technologies of renewable hydrogen production

PHASE #1: THE ROADMAP CONSTRUCTION - 2004 a 2005

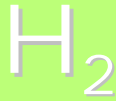


- 1 – Basis for the Development of a Hydrogen Market
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➤ The **REGULATION** will be oriented with a market priority in order to create an adequate environment for business in the hydrogen chain supply.

➤ It is necessary to plan the role of **NATIONAL GOODS AND SERVICES INDUSTRY** giving the necessary instruments in order to make it competitive in a global basis.

PHASE #1: THE ROADMAP CONSTRUCTION - 2004 a 2005



- 1 – Basis for the Development of a Hydrogen Market
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➤ Brazil will multiply the organization of **TECHNOLOGICAL AND MULTILEVELD PROGRAMS** given the natural vocation on hydrogen production and utilization.

➤ Brazil will seek **STRATEGIC PARTNERSHIPS** with countries that detain solid technological and industrial basis in order to anticipate the production of hydrogen from the ethanol, mainly.

PHASE #1: THE ROADMAP CONSTRUCTION - 2004 a 2005



1 – Basis for the Development of a Hydrogen Market

2 – Production of Hydrogen

3 – Logistics: Storage, Transport and Distribution

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5 – Applications: Hydrogen as na Energy Vector

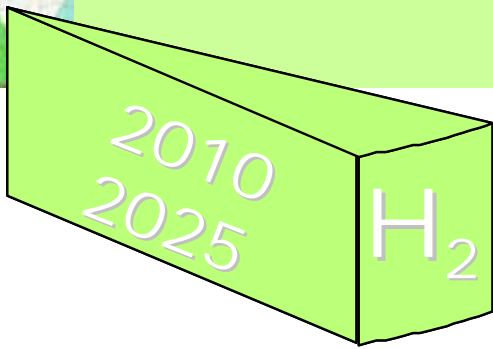
6 – Technological and Human Resources Development

7 – Metrology, Standardization, Conformity Evaluation, Regulation and Fiscalization

➤ The **DISTRIBUTED GENERATION** and reaching isolated communities are market niches to be explored in priority.

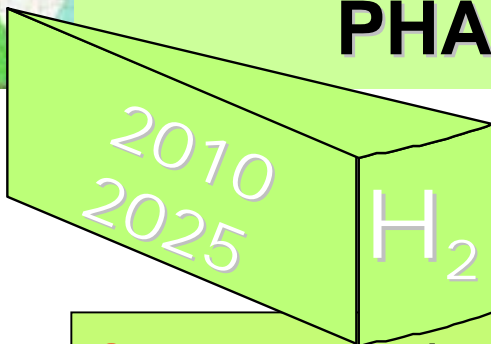
➤ Among vehicles applications, those directed to **HEAVY VEHICLES** for cargo and urban passenger transport stands as priority as weel.

PHASE #1: PRIORITIES



- **Priority “A”: Ethanol Reform - 2020**
- **Priority “B”: Water Electrolysis - 2015**
- **Priority “C”: Natural Gas Reform - 2010**
- **Priority “D”: BIOMASS Gasification and ALTERNATIVE PROCESSES - 2025**

PHASE 1: ETHANOL MILESTONES



HYDROGEN / ETHANOL PRODUCTION ACTIVITY

Catalysts: Year of 2010

Reactors up to 10 kW: Year of 2012

Reactors from 10 to 50 kW: Year of 2015

Reactors from 50 to 500 kW: Year of 2020

HYDROGEN / ETHANOL LOGISTIC INFRASTRUCTURE ACTIVITY

Pipe Gas construction for Hydrogen transport: Year of 2015

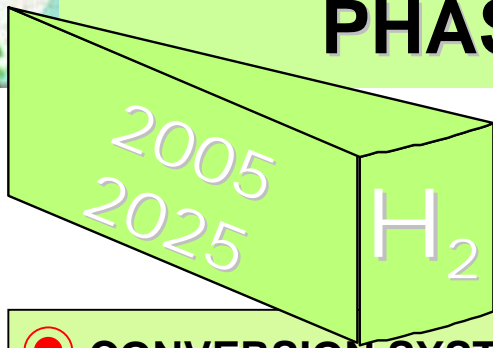
Storage in Pressure Vessels: Year of 2010

Storage in Solid Structures: Year of 2015

Storage in Large Quantities: Year of 2020

Distribution in Gas Stations: Year of 2010

PHASE 1: ETHANOL MILESTONES



● CONVERSION SYSTEMS OF HYDROGEN / ETHANOL ACTIVITY

Polymer Membrane Cells from 5 kW: Year of 2005

Polymer Membrane Cells 200 kW and Solid Oxide Cells 10 kW : Year of 2010

Polymer Membrane Cells 250 kW and Solid Oxide Cells 50 kW : Year of 2015

Direct Ethanol Cells and Solid Oxide Cells of 500 kW : Year of 2020

Energy Generation from Hydrogen Combustion – 5 kW: 2005

Energy Generation from Hydrogen Combustion – 50 kW: 2010

● HYDROGEN / ETHANOL APPLICATIONS ACTIVITY

Stationary Generation with Polymer Membrane Cells of 10 kW: Year of 2015

Cargo and Urban Passenger Transport: Year of 2020



PHASE 1: ETHANOL MILESTONES



SUBPROGRAM ETHANOL: ETHANOL's REFORMING (Beta Version)

Id	Nome da Atividade	Duração	Início	Término	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	1st STAGE - DEVELOPMENT OF THE ROADMAP FOR STRUCTURING THE HYDROGEN ECONOMY IN BRAZIL	4 meses	1/11/04	18/2/05																	
2	2nd STAGE - ESTABLISHMENT OF THE PROJECTS PORTFOLIO - DEVELOPMENT OF THE ACTION PLAN FOR ETHANOL SUBPROGRAM	20 meses	1/4/05	12/10/06																	
37	3rd STAGE - ROAD MAP REVISION - VERSION I	4 meses	9/11/06	28/2/07																	
38	4th STAGE - PREPARATION FOR LAUNCH OF GOVERNMENTAL PROGRAM FOR HYDROGEN PRODUCTION AND USE IN BRAZIL	3 meses	1/1/07	23/3/07																	
39	5th STAGE - DEVELOPMENT, IMPLANTATION AND ACOMPLISHMENT OF HYDROGEN COMERCIAL USE AND PRODUCTION FROM ETHANOL (details in the folowing spread sheet)																				
40	Global Milestones																				
41	Activity: Hydrogen Production / Ethanol																				
42	Catalysts																				
43	Reactors for 10 kW																				



PHASE 1: ETHANOL MILESTONES



SUBPROGRAM ETHANOL: ETHANOL's REFORMING (Beta Version)

Id	Nome da Atividade	Duração	Início	Término	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
44	Reactors for 10 to 50 kW															●					
45	Reactors for 50 to 500 kW																				●
46	Activity: Logistic Infrastructure for Hydrogen / Ethanol																				
47	- Transportation															●					
48	Storage																				
49	Pressurized Vessels										●										
50	Solid Structures															●					
51	Storage in Huge Amounts																				●
52	Distribution																				





PHASE 1: ETHANOL MILESTONES



SUBPROGRAM ETHANOL: ETHANOL's REFORMING (Beta Version)

Id	Nome da Atividade	Duração	Início	Término	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
53	Hydrogen Fueling Stations																				
54	Activity: Conversion Systems																				
55	Proton Exchange Membrane Fuel Cell - 5 kW																				
56	Proton Exchange Membrane Fuel Cell of 200 kW and Solid Oxide Fuel Cell of 10 kW																				
57	Proton Exchange Membrane Fuel Cell of 250 kW and Solid Oxide Fuel Cell of 50 kW																				
58	Solid Oxide Fuel Cell of 500 kW and Direct Ethanol Fuel Cell																				
59	Energy Generation from Hydrogen Combustion - 5 kW																				
60	Energy Generation from Hydrogen Combustion - 50 kW																				
61	Activity: Applications																				





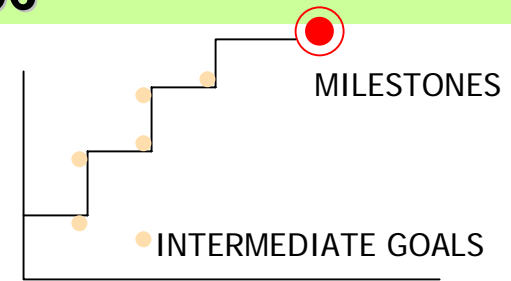
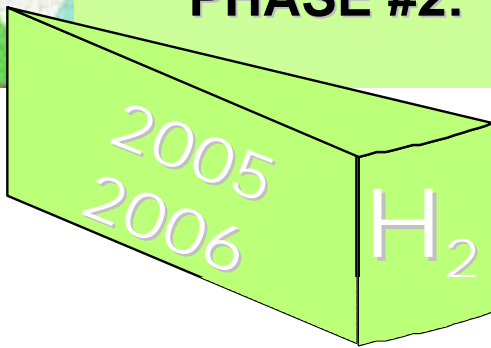
PHASE 1: ETHANOL MILESTONES



SUBPROGRAM ETHANOL: ETHANOL's REFORMING (Beta Version)

Id	Nome da Atividade	Duração	Início	Término	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
62	Stationary Generation by means of Ethanol and Polymeric Fuel Cells until 10 kW															◆					
63	Buses and Heavy Duty Transportation																				◆

PHASE #2: The organization and development of estructural projects - 2005 to 2006



➤ Organization of Action Plans:

- It will contain: goals, schedules, strategies and responsibilities;
- It will be organized considering the established global milestones.

➤ Divided in 4 Subprograms:

- Ethanol Subprogram;
- Water Subprogram;
- Natural Gas Subprogram;
- BIOMASS and ALTERNATIVE PROCESSES.

PHASE #2: The organization and development of estructural projects - 2005 to 2006

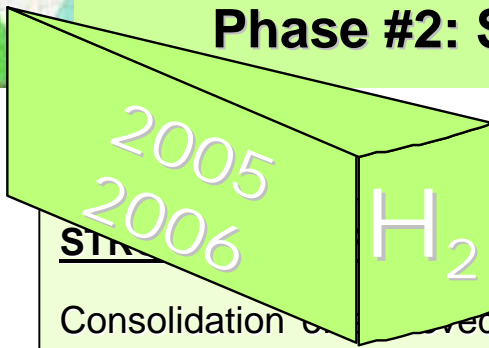


PHASE #2: The organization and development of estructural projects

- Technological Development
- Assembling of Pilot Plants
- Market Mapping and Quantification
- Goods and Services Industry Development
 - The Development of Systems of Hydrogen Production
 - The Development of Infraestructure for Comercializaaton
 - The Development of Systems of Energy Conversion
- Establishment of a Regulatory Legislation
- Constitution of Lines of Credit
- Taxation and Price Formation
- Environment Studies

**DECISION
POINTS**

Phase #2: Structuring Projects – Technological Development



STRUCTURING PROJECT #1 – EXISTING HYDROGEN KNOWLEDGE / ETHANOL

Consolidation of previous results on hydrogen production from ethanol in Brazil, as well as of institutions working on it and projects on the way, developed by Brazilian Universities, fuel cell and other companies.

Terms for Action Plans development: 5 months

Period: May/ 05 to September/ 05

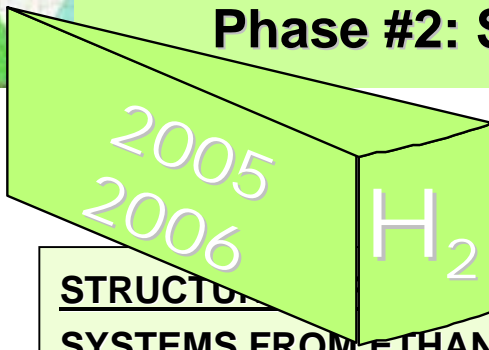
STRUCTURING PROJECT #2 – HYDROGEN TECHNOLOGY NETWORKS / ETHANOL

Structuring of Research, Development and Technology Support Networks for creation and consolidation of Knowledge Basis in Brazil, considering the search for strategic partnerships, including foreign countries, based on the hydrogen production from ethanol reforming.

Terms for Action Plans development: 9 months

Period: July/ 05 to March/ 06

Phase #2: Structuring Projects – Technological Development



STRUCTURING PROJECT #3 – R&D PROJECT PORTFOLIO FOR HYDROGEN PRODUCTION SYSTEMS FROM ETHANOL

Research projects portfolio formatting for development of hydrogen production from ethanol. Projects will focus on the development of reformers, catalysts, materials, purification elements and others.

Terms for Action Plans development: 9 months

Period: July/ 05 to March/ 06

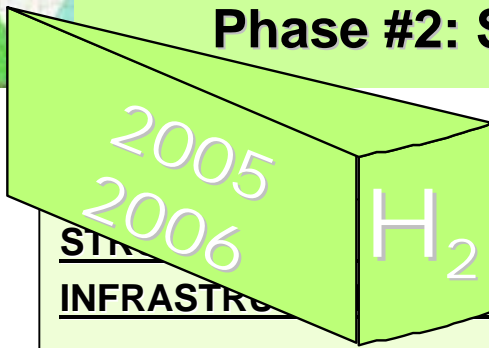
STRUCTURING PROJECT #4 – PROJECT PORTFOLIO FOR HYDROGEN TRANSPORTATION INFRASTRUCTURE / ETHANOL

Research projects portfolio formatting for development of hydrogen transportation from ethanol. Projects will focus on the development of pipelines and other technologies for hydrogen transportation / Ethanol.

Terms for Action Plans development: 9 months

Period: July/ 05 to March/ 06

Phase #2: Structuring Projects – Technological Development



STRUCTURING PROJECT #5 – PROJECT PORTFOLIO FOR HYDROGEN STORAGE INFRASTRUCTURE / ETHANOL

Research projects portfolio formatting for development of storage of the hydrogen from ethanol. Projects will focus on the development of storage systems based on pressurized vessels, solid structures and other technologies for hydrogen storage / Ethanol.

Terms for Action Plans development: 9 months

Period: July/ 05 to March/ 06

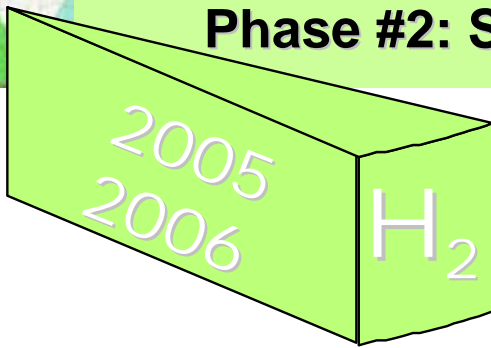
STRUCTURING PROJECT #6 – PROJECT PORTFOLIO FOR HYDROGEN DISTRIBUTION INFRASTRUCTURE / ETHANOL

Research projects portfolio formatting for development of supply chain for hydrogen obtained from ethanol, focusing distribution area. Projects will focus on the development of systems for hydrogen distribution / Ethanol.

Terms for Action Plans development: 9 months

Period: July/ 05 to March/ 06

Phase #2: Structuring Projects – Technological Development



STRUCTURING PROJECT #7 – R&D PROJECT PORTFOLIO FOR FUEL CELLS BASED ON HYDROGEN FROM ETHANOL - PROCaC

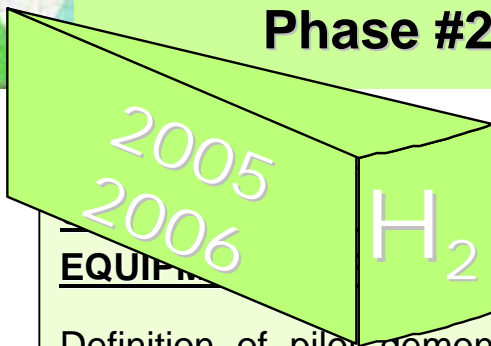
Research projects portfolio formatting for development of supply chain for hydrogen from ethanol, focusing on conversion systems. Projects will focus on the development of Polymer Membrane Cells, Direct Ethanol Cells and Solid Oxide Cells, as well as internal combustion engines fueled with pure hydrogen and hydrogen/natural gas mixture.

Terms for Action Plans development: 9 months

Period: July/ 05 to March/ 06

Phase #2: Structuring Projects – Assembling Pilot Plants

Assembling Pilot Plants



PROJECT #8 – DEMONSTRATION PILOTS FOR PROCESSES AND EQUIPMENT OPTIMIZATION

Definition of pilot demonstration projects portfolio to be built during next years, focusing on processes, equipments and components optimization for hydrogen economy to make effective the Ethanol based Hydrogen Economy in Brazil.

Terms for Action Plans development: 9 months

Period: August/ 05 to April/ 06

Market Mapping and Quantification

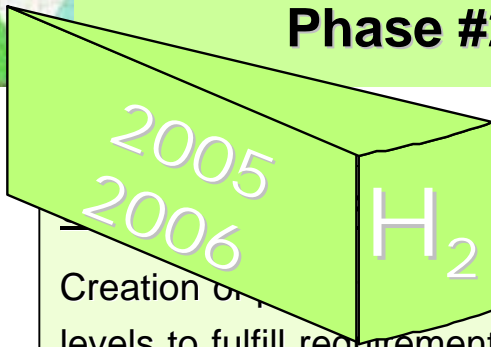
STRUCTURING PROJECT #9 – IDENTIFICATION AND QUANTIFICATION OF POTENCIAL HYDROGEN USE MARKETS / ETHANOL

Identification of Hydrogen / Ethanol application market niches, based on the installed ethanol production and distribution infrastructure, on potential consumers demand and on technology and energy estimated costs.

Terms for Action Plans development: 9 months

Period: August/ 05 to April/ 05

Phase #2: Structuring Projects – Industry Development



PROJECT #10 – HUMAN RESOURCES

Creation of... will develop human resources at technical, undergraduate and graduate levels to fulfill requirements of the ethanol produced hydrogen supply chain. Production, logistics, conversion systems and utilization areas will be taken into account.

Terms for Action Plans development: 11 months

Period: August/ 05 to June/ 06

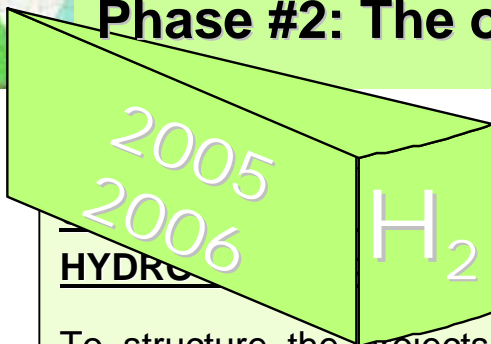
STRUCTURING PROJECT #11 – CREATION OF INDUSTRIAL BASIS FOR HYDROGEN CHAIN / ETHANOL

Formatting projects for the creation of high technology industrial basis, considering, among other alternatives, the incubation of companies as well as the creation of strategic partnerships with foreign companies which would be interested to start activities related to ethanol produced hydrogen industry.

Terms for Action Plans development: 11 months

Period: August/ 05 to June/ 06

Phase #2: The organization and development of structuring projects



PROJECT #12 – SYSTEMS OF CONVERSION FROM ETHANOL TO HYDROGEN AT COMMERCIAL SCALE

To structure the projects for development and assembling of ethanol reformers for hydrogen production, with emphasis on developing catalysts for reforming, on materials for reactors construction and for elements of hydrogen purifying.

Terms for Action Plans development: 11 months

Period: August/ 05 to June/ 06

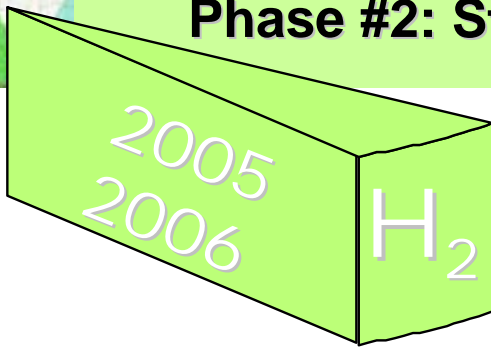
STRUCTURING PROJECT #13 – LOGISTICS INFRASTRUCTURE FOR HYDROGEN / ETHANOL: STORAGE, TRANSPORT AND DISTRIBUTION

To structure the projects for development and implementation of transport infrastructure for the hydrogen from the ethanol reform, with emphasis on vessels and cylinder pressure installed on heavy trucks, pipe gas hydrogen dedicated as well as shared with natural gas and hydrogen

Terms for Action Plans development: 11 months

Period: August/ 05 to June/ 06

Phase #2: Structuring Projects – Goods and Service Industry



STRUCTURING PROJECT #14 – PRODUCTION OF FUEL CELLS ON COMMERCIAL SCALE

To structure the projects for development of fuel cells on commercial scale, with emphasis mainly on Polymer Membrane Cells, Direct Ethanol Cells and Solid Oxide Cells.

Terms for Action Plans development: 11 months

Period: August/ 05 to June/ 06

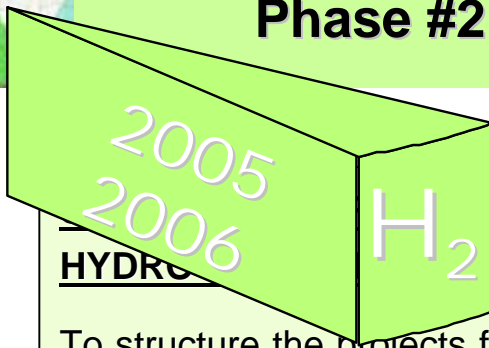
STRUCTURING PROJECT #15 – PRODUCTION OF INTERNAL COMBUSTION ENGINES ON COMMERCIAL SCALE

To structure the projects for development of internal combustion engines on commercial scale, to consume pure hydrogen or a hydrogen blend with natural gas.

Terms for Action Plans development: 11 months

Period: August/ 05 to June/ 06

Phase #2: Structuring Projects – Regulatory Legislation



STRUCTURING PROJECT #16 – ESTABLISHMENT OF A REGULATORY LEGISLATION ON HYDROGEN / ETHANOL SUPPLY CHAIN

To structure the projects for preparing a legal basis and/ or legal reform towards regulation of the supply chain of hydrogen produced from ethanol reform, in order to permit commercialization, the use and quality control of hydrogen for energetic purposes and its blends with natural gas in different proportions.

Terms for Action Plans development: 7 months

Period: May/ 05 to November/ 05

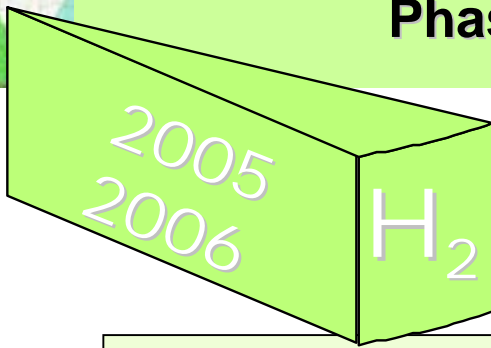
STRUCTURING PROJECT #17 – ESTABLISHMENT OF STANDARDS AND PATTERNS ON HYDROGEN / ETHANOL SUPPLY CHAIN

To structure the projects for preparing the rules for implementing a quality control net capable of ensuring to consumers safety and quality in all supply chain of hydrogen produced from ethanol reform for energetic purposes.

Terms for Action Plans development: 7 months

Period: May/ 05 to November/ 05

Phase #2: Structuring Projects – Credit Lines



STRUCTURING PROJECT #18 – EVALUATION OF PROGRAMS AND EXISTING FUNDS

To structure the projects for evaluating programs and existing funds with emphasis on detailing the official credit programs of the Federal Government, on identifying barriers for the traditional credit programs and on detailing hedge funds for covering financial risks.

Terms for Action Plans development: 9 months

Period: May/ 05 to January/ 06

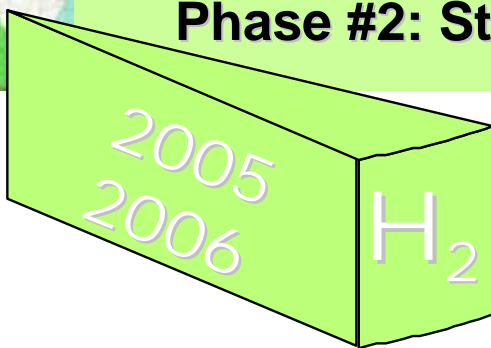
STRUCTURING PROJECT #19 – CREATING CREDIT LINES

To structure the projects for studying financing models focused on evaluating possibilities of connecting the credit lines of the different phases of supply chain, identifying new partners and identifying the major problems regarding credit access according to the chain steps.

Terms for Action Plans development: 6 months

Period: May/ 05 to October/ 05

Phase #2: Structuring Projects – Taxation and Price Definition



STRUCTURING PROJECT #20 – DEFINITION OF TAXATION MODEL FOR THE HYDROGEN / ETHANOL SUPPLY CHAIN

To structure the projects for defining the taxation policy for the commercialization of the hydrogen produced from the ethanol reform for energetic purposes in Brazil.

Terms for Action Plans development: 12 months

Period: May/ 05 to April/ 06

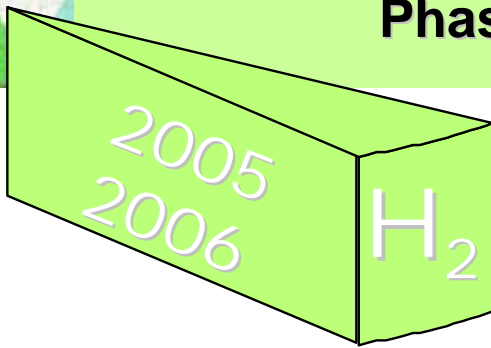
STRUCTURING PROJECT #21 – DEFINITION OF PRICE DEFINITION POLICY FOR THE HYDROGEN / ETHANOL SUPPLY CHAIN

To structure the projects for simulating price definition for the commercialization of the hydrogen produced from the ethanol reform for energetic purposes in Brazil, with the aim to evaluating the impact of decisions already made.

Terms for Action Plans development: 12 months

Period: May/ 05 to April/ 06

Phase #2: Structuring Projects – Environment



STRUCTURING PROJECT #22 – ENVIRONMENTAL STUDIES FOR THE HYDROGEN / ETHANOL SUPPLY CHAIN








To structure the projects to accomplish environmental research related to each step of the hydrogen supply chain with emphasis on the evaluation of environmental benefits and emission studies.

Terms for Action Plans development: 10 months

Period: May/ 05 to February/ 06

ETHANOL SUBPROGRAM – PROJECTS PORTFOLIO

SUBPROGRAM ETHANOL: ETHANOL's REFORMING (Beta Version)

Id	Nome da Atividade	Duração	Início	Término	2005												2006	
					Nov	Dez	Jan	Fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov	Dez
1	1st STAGE - DEVELOPMENT OF THE ROADMAP FOR STRUCTURING THE HYDROGEN ECONOMY IN BRAZIL	4 meses	1/11/04	18/2/05														
2	2nd STAGE - ESTABLISHMENT OF THE PROJECTS PORTFOLIO - DEVELOPMENT OF THE ACTION PLAN FOR ETHANOL SUBPROGRAM	20 meses	1/4/05	12/10/06														
3	Assessment of Project Proposals by Executive Committee	1 mês	1/4/05	28/4/05														
4	Assessment of Project Progress by the Executive Committee	1 mês	1/12/05	28/12/05														
5	Assessment of Project Action Plans by the Executive Committee	1 mês	15/9/06	12/10/06														
6	PROJECT PORTFOLIO - SUBJECT AREAS																	
7	AREA: Technological Development - Hydrogen / Ethanol	11 meses	2/5/05	3/3/06														
8	Project N° 1 - Existing Hydrogen Knowledge in Brazil / Ethanol	5 meses	2/5/05	16/9/05														
9	Project N° 2 - Hydrogen Technology Networks / Ethanol	5 meses	4/7/05	18/11/05														

ETHANOL SUBPROGRAM – PROJECTS PORTFOLIO

SUBPROGRAM ETHANOL: ETHANOL's REFORMING (Beta Version)

Id	Nome da Atividade	Duração	Início	Término	2005		2006												
					Nov	Dez	Jan	Fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov	Dez	Jan
10	Project N° 3 - R&D Project Portfolio for Hydrogen Production Systems from Ethanol	9 meses	27/6/05	3/3/06															
11	Project N° 4 - Project Portfolio for Hydrogen Transportation Infrastructure / Ethanol	9 meses	27/6/05	3/3/06															
12	Project N° 5 - Project Portfolio for Hydrogen Storage Infrastructure / Ethanol	9 meses	27/6/05	3/3/06															
13	Project N° 6 - R&D Project Portfolio for Hydrogen Transportation Infrastructure / Ethanol	9 meses	27/6/05	3/3/06															
14	Project N° 7 - R&D Project Portfolio for Fuel Cells based on Hydrogen from Ethanol - PROCaC	9 meses	27/6/05	3/3/06															
15	AREA: Building of Demonstration Pilots - Hydrogen / Ethanol	9 meses	1/8/05	7/4/06															
16	Project N° 8 - Demonstration Pilots for Processes and Equipments Optimization	9 meses	1/8/05	7/4/06															
17	AREA: Market Mapping and Quantification - Hydrogen / Ethanol	9 meses	1/8/05	7/4/06															
18	Project N° 9 - Identification and Quantification of Potential Hydrogen Use Markets / Ethanol	9 meses	1/8/05	7/4/06															



ETHANOL SUBPROGRAM – PROJECTS PORTFOLIO

SUBPROGRAM ETHANOL: ETHANOL's REFORMING (Beta Version)

Id	Nome da Atividade	Duração	Início	Término			2005												2006	
					Nov	Dez	Jan	Fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov	Dez	Jan	
19	AREA: Development of Industry - Hydrogen / Ethanol	11 meses	1/8/05	2/6/06																
20	Project N° 10 - Human Resources	11 meses	1/8/05	2/6/06																
21	Project N° 11 - Creation of Industrial Basis for Hydrogen Chain / Ethanol	11 meses	1/8/05	2/6/06																
22	Project N° 12 - Commercial Hydrogen to Ethanol Conversion Systems	11 meses	1/8/05	2/6/06																
23	Project N° 13 - Hydrogen Logistics Infrastructure: Transportation, Storage and Distribution / Ethanol	11 meses	1/8/05	2/6/06																
24	Project N° 14 - Fuel Cell Production at Commercial Scale	11 meses	1/8/05	2/6/06																
25	Project N° 15 - Internal Combustion Engines Production at Commercial Scale	11 meses	1/8/05	2/6/06																
26	AREA: Creation of Regulatory Environment for Hydrogen Utilization / Ethanol	7 meses	2/5/05	11/11/05																
27	Project N° 16 - Regulatory Marks for Hydrogen Chain / Ethanol	7 meses	2/5/05	11/11/05																

ETHANOL SUBPROGRAM – PROJECTS PORTFOLIO

SUBPROGRAM ETHANOL: ETHANOL's REFORMING (Beta Version)

Id	Nome da Atividade	Duração	Início	Término	2005		2006												
					Nov	Dez	Jan	Fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov	Dez	Jan
28	Projeto Estruturante N° 17 - Development of Codes and Standars for the hydrogen Chain / Ethanol	7 meses	2/5/05	11/11/05															
29	AREA: Funding - Hydrogen / Ethanol	9 meses	2/5/05	6/1/06															
30	Project N° 18 - Assessment of Existing Funding Mechanisms	9 meses	2/5/05	6/1/06															
31	Project N° 19 - Funding Formatting for Hydrogen Chain / Ethanol	6 meses	2/5/05	14/10/05															
32	AREA: Tax and Prices - Hydrogen / Ethanol	12 meses	2/5/05	31/3/06															
33	Project N° 20 - Definition of Taxation Model for Hydrogen Chain / Ethanol	12 meses	2/5/05	31/3/06															
34	Project N° 21 - Definition of Price Policy for Hydrogen Chain / Ethanol	12 meses	2/5/05	31/3/06															
35	AREA: Environment - Hydrogen / Ethanol	10 meses	2/5/05	3/2/06															
36	Project N° 22 - Environmental Studies for the Hydrogen Chain / Ethanol	10 meses	2/5/05	3/2/06															



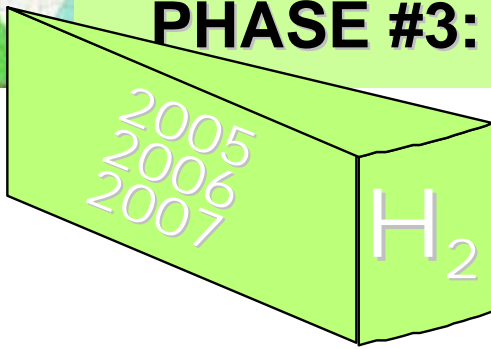
ETHANOL SUBPROGRAM – PROJECTS PORTFOLIO

SUBPROGRAM ETHANOL: ETHANOL's REFORMING (Beta Version)

Id	Nome da Atividade	Duração	Início	Término	2005												2006	
					Nov	Dez	Jan	Fev	Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov	Dez
37	3rd STAGE - ROAD MAP REVISION - VERSION I	4 meses	9/11/06	28/2/07														
38	4th STAGE - PREPARATION FOR LAUNCH OF GOVERNMENTAL PROGRAM FOR HYDROGEN PRODUCTION AND USE IN BRAZIL	3 meses	1/1/07	23/3/07														
39	5th STAGE - DEVELOPMENT, IMPLANTATION AND ACOMPLISHMENT OF HYDROGEN COMERCIAL USE AND PRODUCTION FROM ETHANOL (details in the folowing spread sheet)																	

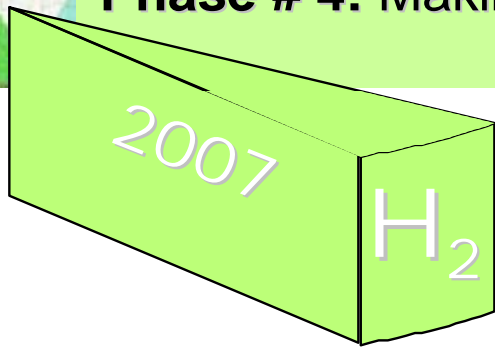


PHASE #3: Roadmap Revision – Version I - 2005 to 2007



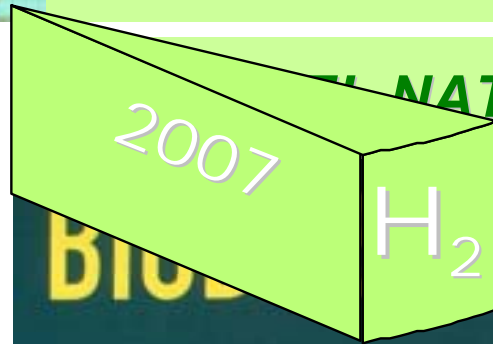
- After the organization and development of structural projects and the organization of related action plans, with the definition of intermediate targets;
- This revision, as well as the others, will take place during the next 20 years driven by the Brazilian reality, considering challenges and opportunities.

Phase # 4: Making of the Governmental Program for Production and Use of Hydrogen in Brazil – 2007



➤ This short period will consists on the consolidation of all documents generated, its communication among the government structure, with the purpose of launching a interministerial program entitled: “Production and Use of Hydrogen in Brazil Program”

Phase # 4: Making of the Governmental Program for Production and Use of Hydrogen in Brazil – 2007



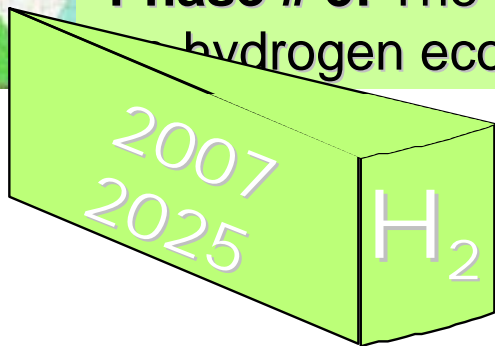
NATIONAL PROGRAM LAUNCHING (12-06-2004)

BIOCOMBUSTÍVEL. O NOVO COMBUSTÍVEL DO BRASIL.

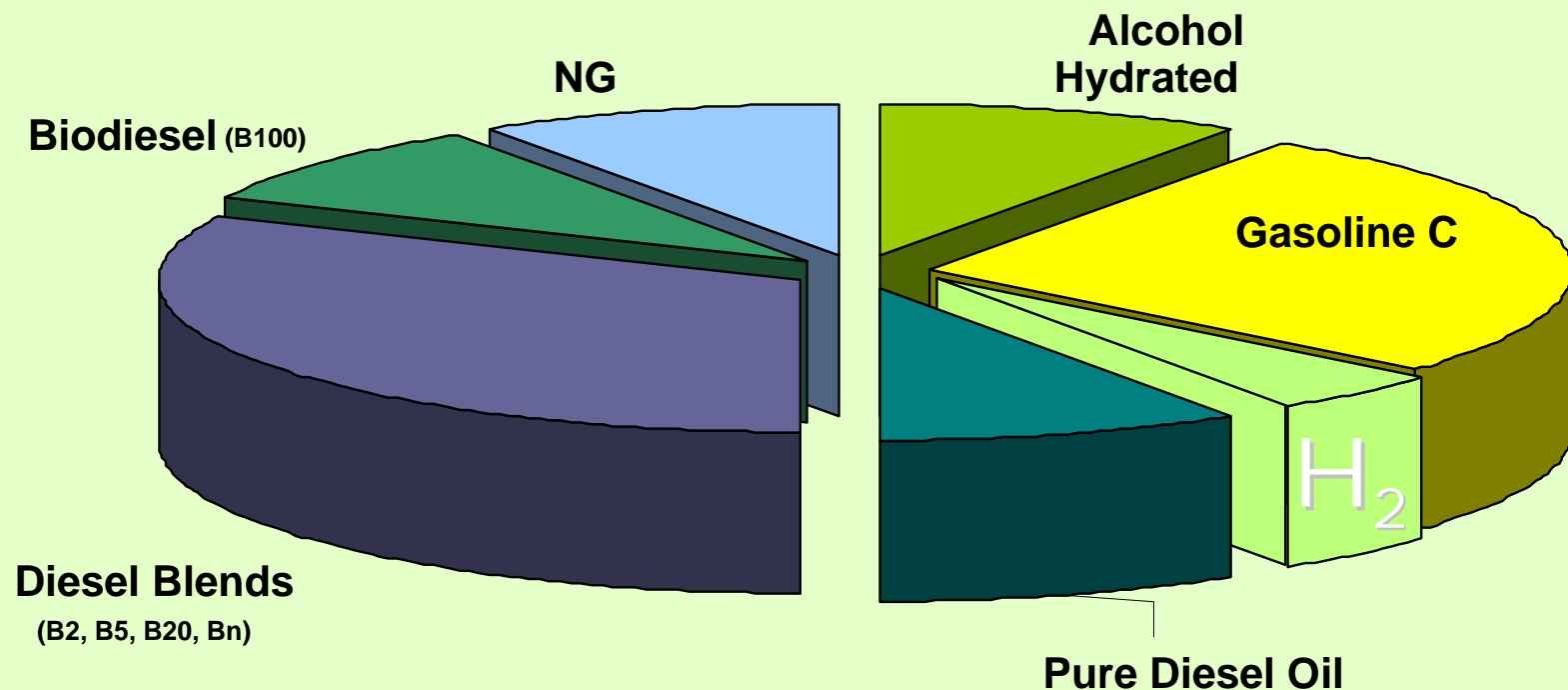
PROGRAMA NACIONAL DE PRODUÇÃO E USO DO BIODIESEL



Phase # 5: The implementation of activities towards the establishment of hydrogen economy in Brazil – 2007 a 2025.



REALITY





THE BRAZILIAN ROADMAP CONSTRUCTION

Operation

Maurício Pereira Cantão – LACTEC

Sub-coordination

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Chapter 2 – Ennio Peres da Silva – UNICAMP

Chapter 3 – Maria Helena Troise Frank – CENPES

Chapter 4 – Paulo Emílio Valadão de Miranda – Coppe/UFRJ

Chapter 5 – Gilson Paulillo – LACTEC

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Chapter 7 – Sérgio Pinheiro de Oliveira - INMETRO