GROUP ELECTROCELL® FUEL CELL ENERGY

UNIVERSIDADE ESTADUAL DO CEARÁ

GOVERNO DO ESTADO DO CEARÁ
Secretaria da Ciência, Tecnologia e Educação Superior

"Estudo de viabilidade técnico-econômica de aplicações estacionária de célula a combustível no Brasil"

Gerhard Ett
Diretor Electrocell
Coordenador ABNT - CB67 - Tecnologia do Hidrogênio e Células a combustível

Hidrogênio e o Futuro Energético Sustentável do Estado do Ceará - 15-16 março de 2011

Nossa História

Fundação: 12 anos

Colaboradores:

- 16 (sendo 6 doutores, 2 mestres, 4 eng., técnicos, químico e adm)

Equipe e Empresa especializada em:

- Células a combustível (15 anos experiência),
- Baterias, (25 anos experiência),
- Tratamento de superfície e corrosão (50 anos experiência),
- Energia (30 anos experiência),
- Desenvolvimento de produtos. (40 anos experiência),

Principais parceiros:

- IPEN, IBG, SABÓ, CIETEC.

Localização:

- **Parque tecnológico da USP**

Reconhecimentos:
2001 – SAE – Motor de Relutância
2004 – CNI/Fiesp Meio Ambiente – Fase Estadual
2004 – CNI Meio Ambiente – Fase Nacional
2006 – FGVSP/CES – New Ventures/WRI
Empresa Sustentável
2008 - Selo ANPEI de Empresa Inovadora
2009 –Premio Finep de Inovação

Célula a Combustível / Fuel Cell

Economia

- Alta Eficiência (60%)
- Custos decrescentes
- Competitivo com bateriais especiais

Meio Ambiente

- Energia limpa
- Sem barulho no seu funcionamento
- Sem emissão de poluentes
- Único resíduo é água pura

Mercado

- Energia estável e de alta qualidade
- Geração distribuída

Journal “Fuel Cell Today” – October - 2006

FUEL CELL TODAY

Opening doors to fuel cell commercialisation

Fuel Cell Today Market Survey: Large Stationary Applications 2006

Kerry-Ann Adamson, Fuel Cell Today, 2 October 2006

Introduction

Over the last year the Large Stationary[1] sector has moved forward substantially. As we mentioned last year, if the 2008 date for commercialisation that was being talked about during 2005 was serious then we would need to see increased activity in a number of areas. These included manufacturing capability, increased funding for units to go into the field and fundamentally increased interest from commercial adopters.

All of these areas have seen activity. Examples include

- **FuelCell Energy** increased its manufacturing capability by a third,
- **Nuvera** teaming up with **Uhdenora** and **Caffaro** targeting Chlorate plants which produce excess hydrogen. By creating a win-win, where the plants use the excess hydrogen to power the fuel cell, not only does the adopter's utilities bills decrease but Nuvera has created a, potentially, large market for its Forza PEM units without the need for additional hydrogen infrastructure.
- Projects with a large increase in MW have been opened for tender (see Funding for more information on this)

FuelCell Energy's new DFC(T)
(picture courtesy of FuelCell Energy)

[1] Fuel Cell Today defines Large Stationary as any unit over 10kW. Units of exactly 10kW are counted in the Small Stationary Survey.

The 1.4 MW UTC fuel cell installation at Garden City, New York
(picture courtesy of UTC)

The other very high profile project that UTC is involved with the Verizon call-switching centre in Garden City, New York. This location is home to 1.4 MW (7 x 200kW units) PAFC power. To date this is the largest such fuel cell project in the world. The units, which have a low sound profile of only 60 dBa, are being run off natural gas or digester gas and are expected to operate in parallel with the grid, under normal operating conditions, or as primary power under grid failure conditions.

Proton Exchange Membrane Fuel Cell (PEMFC)

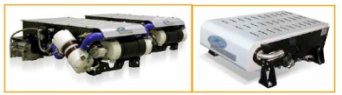
Electrocell (Brazil) is developing 50 and 5kW EcoGem stationary units for the South American market. The 50kW unit can be run off either natural gas or ethanol and is advertised as being very compact. Electrocell also state that they working on units up to 250kW.

The 50kW EcoGem unit from Electrocell
(picture courtesy of Electrocell)

General Motors (USA) is working with **Dow Chemicals** on a large stationary fuel cell project in Freeport, Texas. This project has been ongoing since 2003, with Phase 1 seeing the testing

of single units. Phase 2 was launched late 2004 with multiple fuel cells in use. If this proves successful, and there appears nothing to the contrary so far, then Phase 3 is slated for launch in 2007. Phase 3 could see up to 400 fuel cells providing a total of 35MW of energy.

Hydrogenics (Canada) is now selling a scaleable PEM unit for stationary power. Through its Power Systems subgroup it markets the HyPM XR (shown below). Although the overwhelming majority of its units has so far been sub 10kW this year saw the sale of three 12kW Power Modules to a mobile telecom company in Asia. The units are to be used in a back-up power application. They proprietary Fuel Cell Power Modules are designed to be rack mountable and include all the parts to operate in the telecoms industry.



The HyPM 6S (kW) and HyPM 10 (kW) units from Hydrogenics
(picture courtesy of Hydrogenics)

Nuvera Fuel Cells (Italy/USA) has interests in a number of different application areas using its PEM technology. As well as large and small stationary it is also developing units for light duty vehicles, trains and forklifts. Its Forza Industrial Power 500kW PEM unit is of relevance to this survey. This unit can be used a building block to create multi-MW units. Nuvera has a different market strategy to many other companies and has teamed up with **Uhdenora**, which owns electrochemical plants, to start using the fuel cells in the chlor-alkali market. Within this market it is claimed that large amounts of high-purity hydrogen are released, the equivalent of gas flares in the petrochemical industry. As this hydrogen is essentially a waste product, using it through a fuel cell to generate electricity for the plant is something of a win-win. The first such project was switched on in early July 2006 and will generate 120kW of power. Nuvera claim that 2006 will see the commercial launch of the Forza unit.

[As Ballard Power Systems (Canada) have given no indication that since the 2003 trial of the its 250kW PEM unit any further work on large stationary has been done it has been decided to drop Ballard from this list]

Solid Oxide Fuel Cells (SOFC)

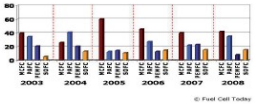
FuelCellToday®
Informing the fuel cell industry

2008 Large Stationary Survey,

Dr. Kerry-Ann Adamson

Fuel Cell Today,
August 2008

Graph 5: Annual Technology Mix, By Percentage Adopted

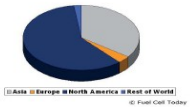


© Fuel Cell Today

Interestingly this is one application where we could see alkaline fuel cells coming back into the frame. AFC Energy has a deal with Akzo Nobel to ship a 50 and a 200 kWe unit, contingent on further development. At present the company's technology has been tested for 5000 hours on a number of cells.

If we look at region of the fuel cell stack manufacture, as shown in Graph 6, it is clear that North America is very strong with around two thirds of the current, 2008, market. This market split has been fairly consistent over the past few years and is anticipated to remain so unless companies such as Rolls Royce and Nuvera, both European companies, decide to manufacture their stacks in Europe and not at their North American plants. At present the Rest of the World category has really only one serious player, ElectroCell (Brazil), which is developing PEM technology for both small and large scale applications. BHEL (India), which is also developing PEM technology, is currently at development scale testing.

Graph 6: Region of Stack Manufacture



© Fuel Cell Today

It is interesting to note that this application has the highest sensitivity of all the different fuel cell sectors to company / commercial development. At present this application has only ten companies capable of producing stacks for products that are not classed as late stage R&D. Of these ten less than half can be considered commercial and only around three quarters are focusing solely on this sector. Going forward there is another ten or so companies potentially coming on stream in the next five years taking the market up to around 20 companies. With the low number of companies operating in this sector any fall out, in terms of company closure or sell off, has real implications for the growth of the entire market. HydroGen for example, which has had a positive year in terms of its market development with Samsung, has subsequently also had to lay off two third of its staff and is in talks to secure short term financing. At the start of FY08 it was expected that within twelve months HydroGen would see the sale and shipment of two, 2MW units to Samsung for use as power plants in Korea. Although this is only two systems this 4 MW represents around 8% of the total installed capacity of 2008 as shown in Graphs 1 and 3. SOFC units are coming increasingly close to market with Phase 1 SECA targets being met. In contrast to this the statement given by Siemens as to why it has put up for sale its SOFC business unit, which was working on MW class fuel cell systems, is that it does not see this business unit making the desired profit targets by 2010. This short time horizon for profitability of a technology that is still in late stage R&D, primarily funded by government money, is not only highly implausible but signalling, we believe, some other reason for Siemens to once again withdraw from fuel cell development.

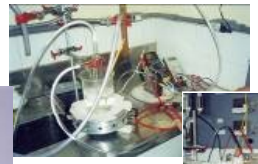
Economics

When looking at the cost structure of large stationary fuel cells there are at present realistically only FuelCell Energy and UTC Power who have costs that are not one-off deals.

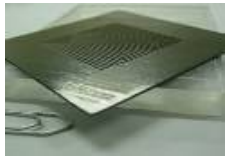
Next year sees the launch of the 400kW PureCell from UTC Power. The company has provided a clear market signal regarding the unit by forward pricing it at US$1 million installed cost, or US$2500 per kW. According to the company's own calculations this brings the unsubsidised electricity price in at US$12 cents per kW/h.

FuelCell Energy is currently reporting electricity prices from its DFC units at US$15 cents per kW/h with a future targeted in-

Cronograma de desenvolvimento



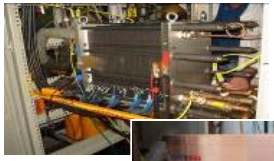


1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

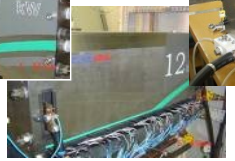






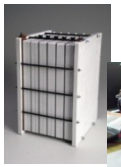
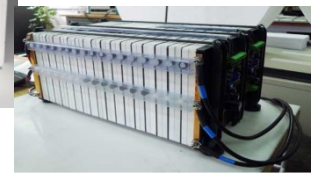







Fuel Cell Technology

Bipolar Battery 2008 2009 2010

Produtos para Apoio para Pesquisa

- **8 tipos de Bancadas de testes**
- **12 tipos de Células a combustível** tipo PEM
- **Unidades estacionárias (7º Geração)**
- Sistema de umidificação
- Placas bi-polares
- MEA’s
- Sensor de hidrogênio
- Carga dinâmica
- Eletrônica de potência
- Eletrônica de controle
- Sistema de segurança
- Controlador mássico de vazão
- Controlador de temperatura

Unidade Back-up - 50kW PEM Fuel Cell

Prêmio CNI 2004

50kW PEM Stationary Fuel cell

Remote Energy Generation

- *Residential*
- Office Building
- Back up Energy

Client: AES/Eletropaulo

Ecogem 50kW

AES Eletropaulo FUSP ipen

Unidade de fabricação de placas bipolares

Dr. Renato Antunes

Brazilian Technology

GROUP ELECTROCELL® FUEL CELL ENERGY

Unidade Back-up - 5kW - Natural Gas

5kW PEM Stationary FC

Up to 25kW

Remote Energy generation

- Residential
- Back up Energy
- Natural Gas reformer integrated

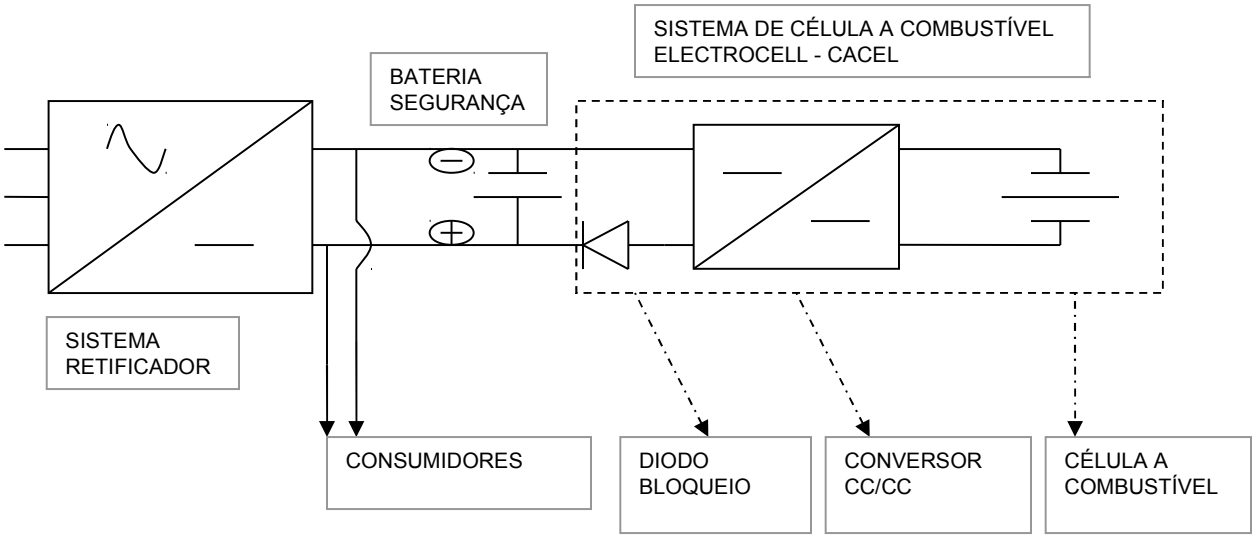
Ecogem 5kW

Client: CEPEL

CEPEL CENTRO DE PESQUISAS DE ENERGIA ELÉTRICA

Chesf

Sistema para TELECOM 5kw - Backup Power



TENSÃO DE SAÍDA DA CÉLULA: 46VCC (TENSÃO MÍNIMA INTERNA ATÉ 53VCC(TENSÃO MÁXIMA DA CÉLULA).

A REGULAGEM DO CONVERSOR CC/CC É DEFINIDA CONFORME FLUTUAÇÃO DO SISTEMA A SER ATENDIDO.

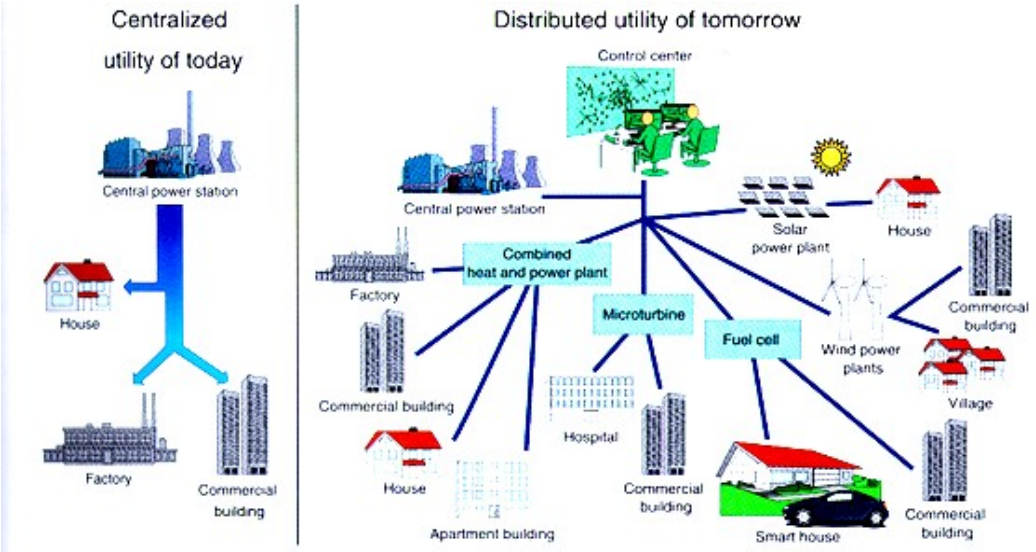
- 5kW DC Output
- Output tension: from 46VCC to 53VCC
- Build according Telecom specifications
- Scalable to until 10 hours of autonomy

Sistema de tração Híbrida: Li Battery / 80kWFuel Cell

UFRJ COPPE: Laboratório de hidrogênio

Mercado de Energia - Tendências

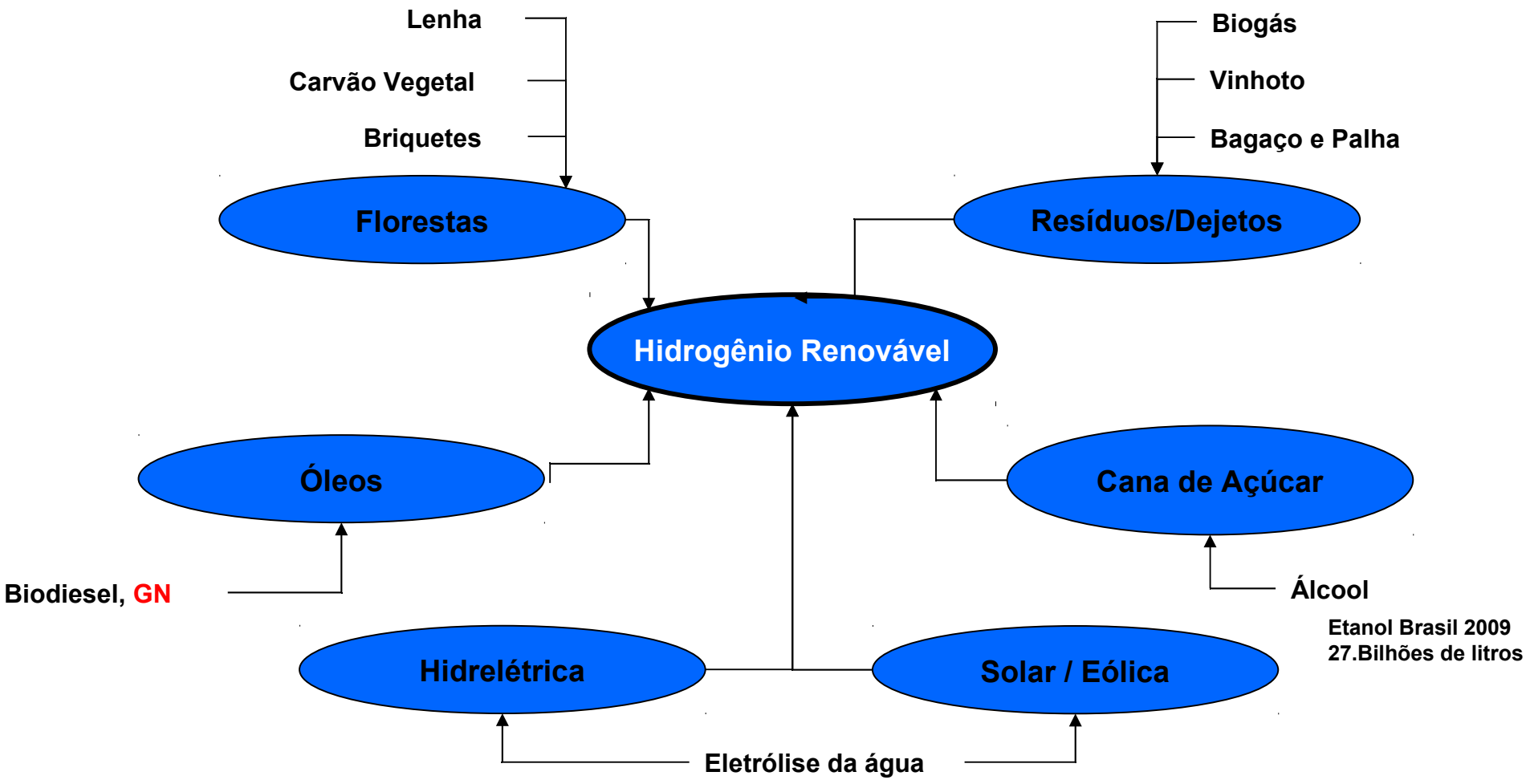
- **Mudança de Geração Centralizada de energia para Geração Distribuída**
  - **Menor Custo de Investimento**
  - **Perdas mínimas na distribuição (normalmente 15% da energia gerada é perdida no transporte aos centros consumidores)**



- **Diversificação da Matriz Energética**
  - **Crescimento das fontes de energia renováveis**
    - **Eólica, solar, PCHs(Pequenas Centrais Hidrelétricas) e CÉLULAS A COMBUSTÍVEL**

Fontes para Geração de Hidrogênio - HOJE

- **Opções de Energia Renovável e não e suas matérias primas**



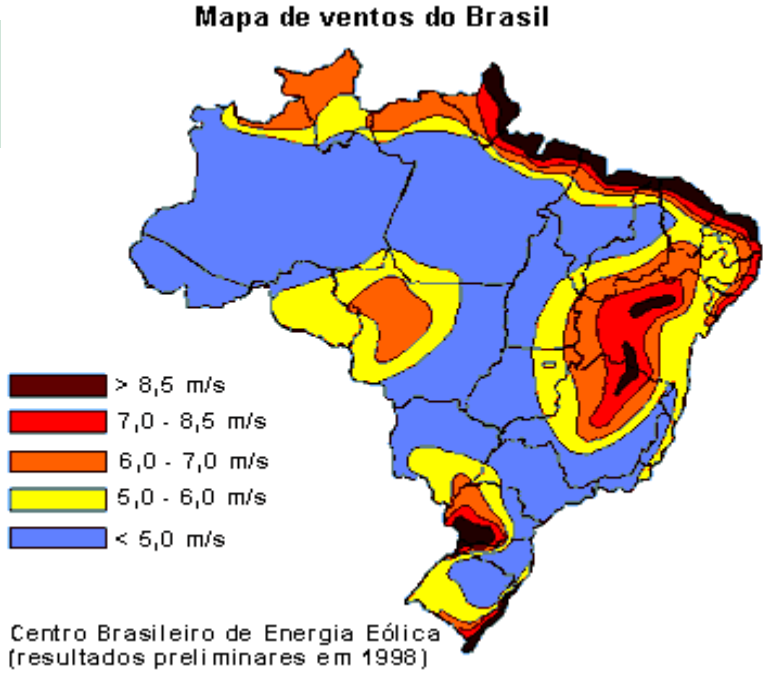
http://www.gasnet.com.br/

Álcoolduto multimodal

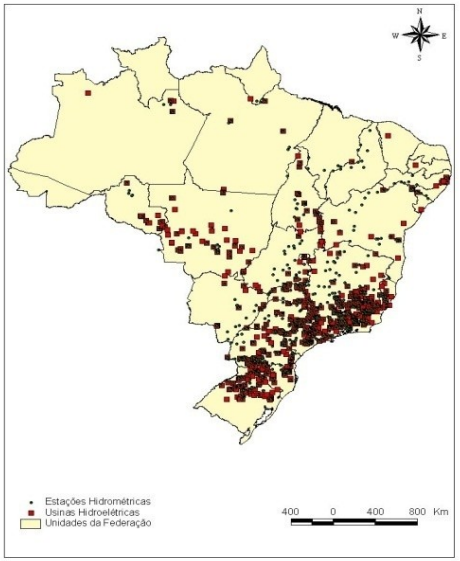
Gasoduto GN

H_2

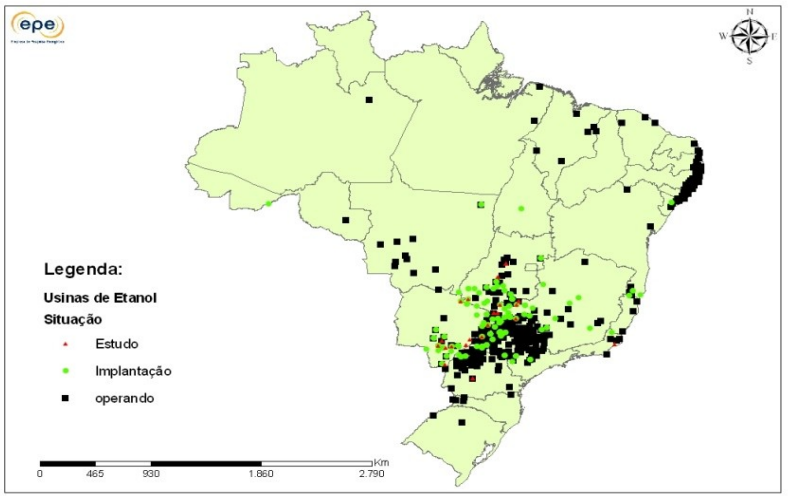
Potencial eólico

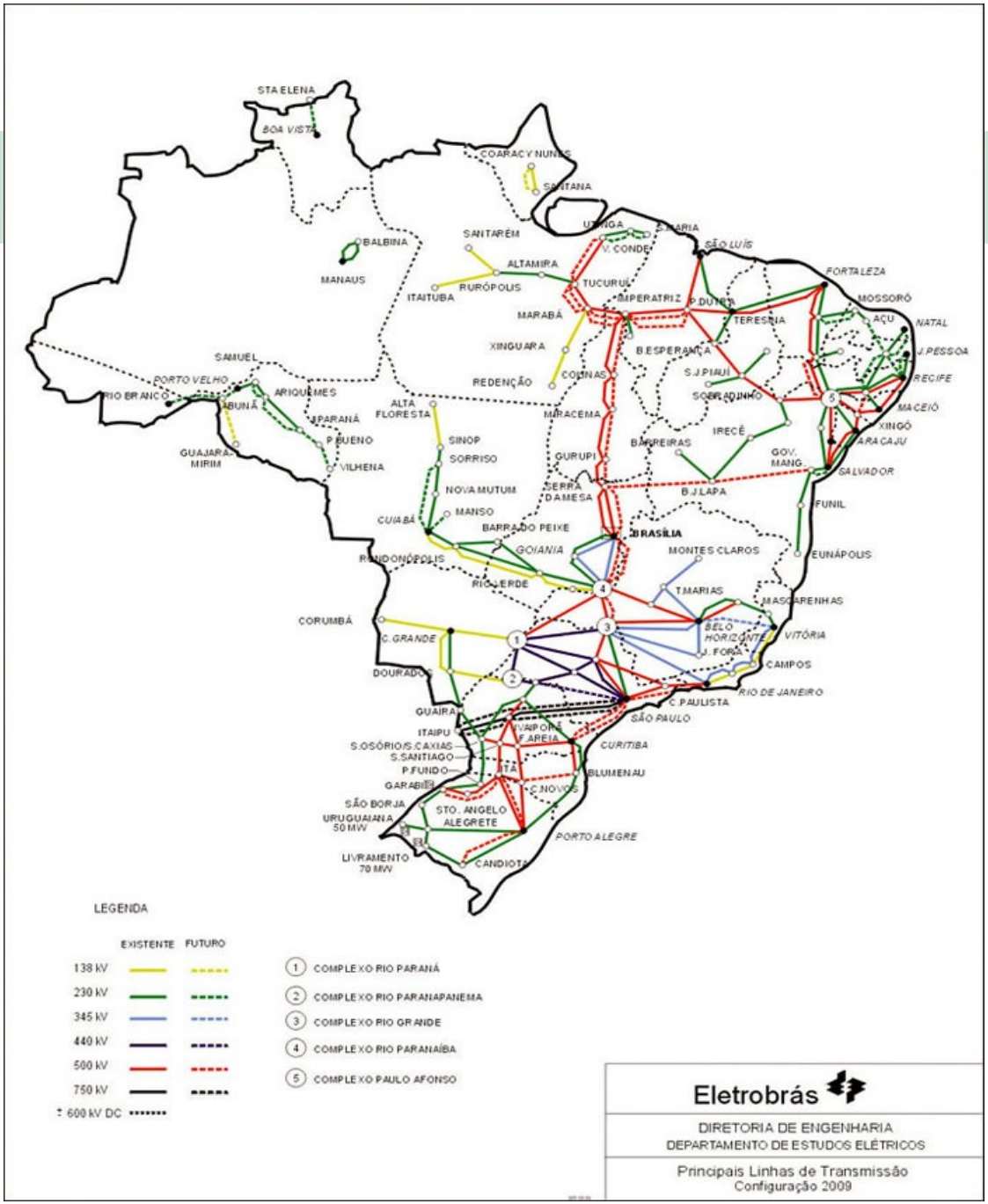


Hidroelétricas

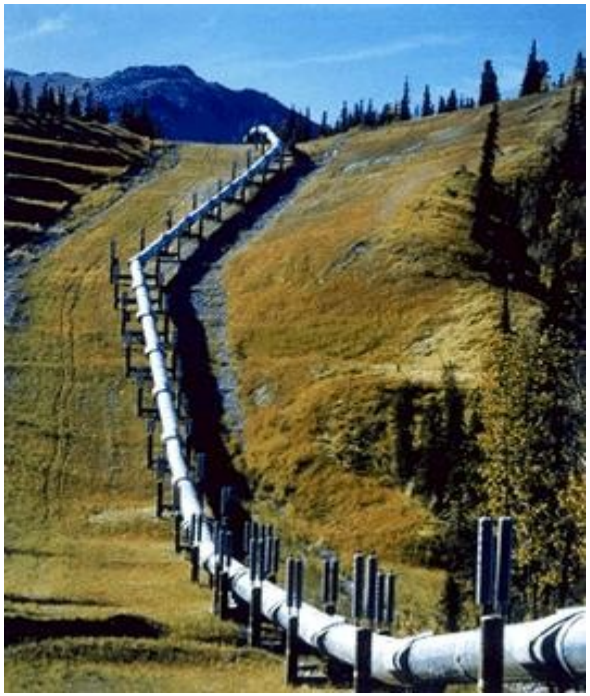


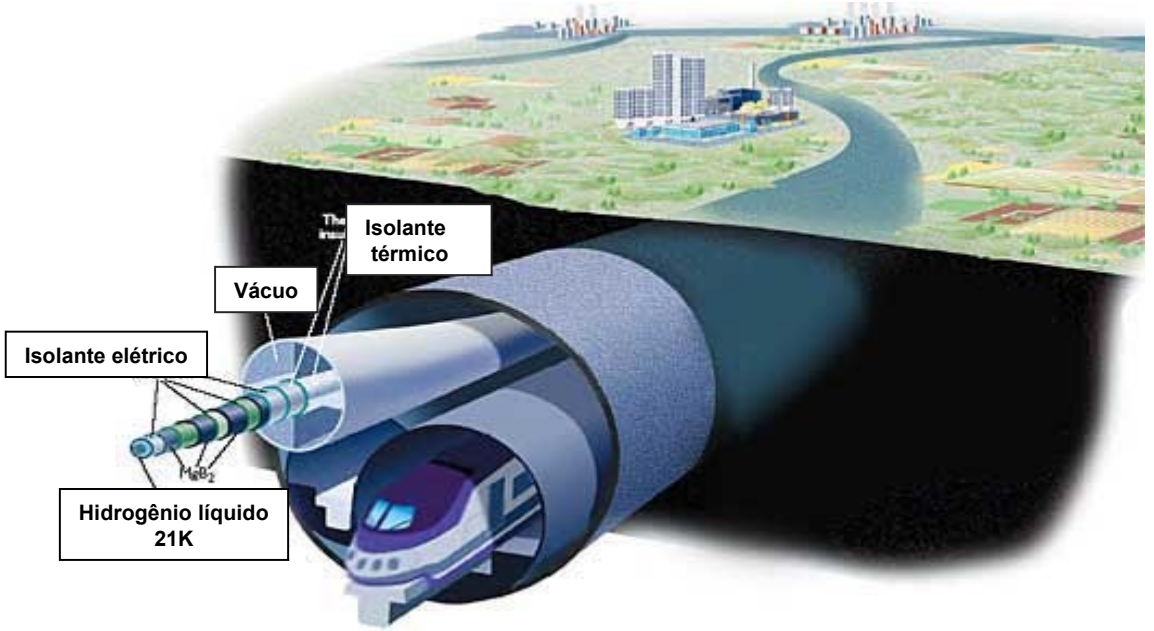
Produção de etanol




STA ELENA
BOA VISTA
BALBINA
MANAUS
COARACY NUNES
SANTANA
SANTARÉM
ALTAMIRA
ITAITUBA
RURÓPOLIS
TUCURUÍ
MARABÁ
XINGUARA
REDENÇÃO
SAMUEL
PORTO VELHO
RIO BRANCO
ABUNÃ
ARIQUEMES
JIPARANÁ
P.BUENO
GUAJARÁ MIRIM
VILHENA
ALTA FLORESTA
SINOP
SORRISO
NOVA MUTUM
CUIABÁ
MANSO
BARRA DO PEIXE
RONDONÓPOLIS
RIO VERDE
GOIÂNIA
CORUMBÁ
C.GRANDE
DOURADOS
GUAÍRA
ITAIPU
S.OSÓRIO/S.CAXIAS
S.SANTIAGO
P.FUNDO
GARABI
SÃO BORJA
URUGUAIANA 50 MW
LIVRAMENTO 70 MW
STO. ANGELO
ALEGRETE
CANDIOTA
PORTO ALEGRE
CURITIBA
BLUMENAU
C.NOVOS
ITÁ
V.CONDE
SÃO LUÍS
IMPERATRIZ
P.DUTRA
TERESINA
FORTALEZA
MOSSORÓ
AÇU
NATAL
J.PESSOA
RECIFE
MACEIÓ
XINGÓ
ARACAJU
SALVADOR
FUNIL
EUNÁPOLIS
MASCARENHAS
VITÓRIA
CAMPOS
RIO DE JANEIRO
SÃO PAULO
C.PAULISTA
J.FORA
BELO HORIZONTE
T.MARIAS
MONTES CLAROS
BRASÍLIA
SERRA DA MESA
GURUPI
MIRACEMA
COLINAS
BARREIRAS
IRECÊ
GOV. MANG.
B.JLAPA
S.J.PIAUÍ
SOBRADINHO
XINGUARA
BESPERANÇA
ITAITUBA
LEGENDA
EXISTENTE
FUTURO
138 kV
230 kV
345 kV
440 kV
500 kV
750 kV
± 600 kV DC
1 COMPLEXO RIO PARANÁ
2 COMPLEXO RIO PARANAPANEMA
3 COMPLEXO RIO GRANDE
4 COMPLEXO RIO PARANAÍBA
5 COMPLEXO PAULO AFONSO
Eletrobrás
DIRETORIA DE ENGENHARIA
DEPARTAMENTO DE ESTUDOS ELÉTRICOS
Principais Linhas de Transmissão
Configuração 2009

Tendências?

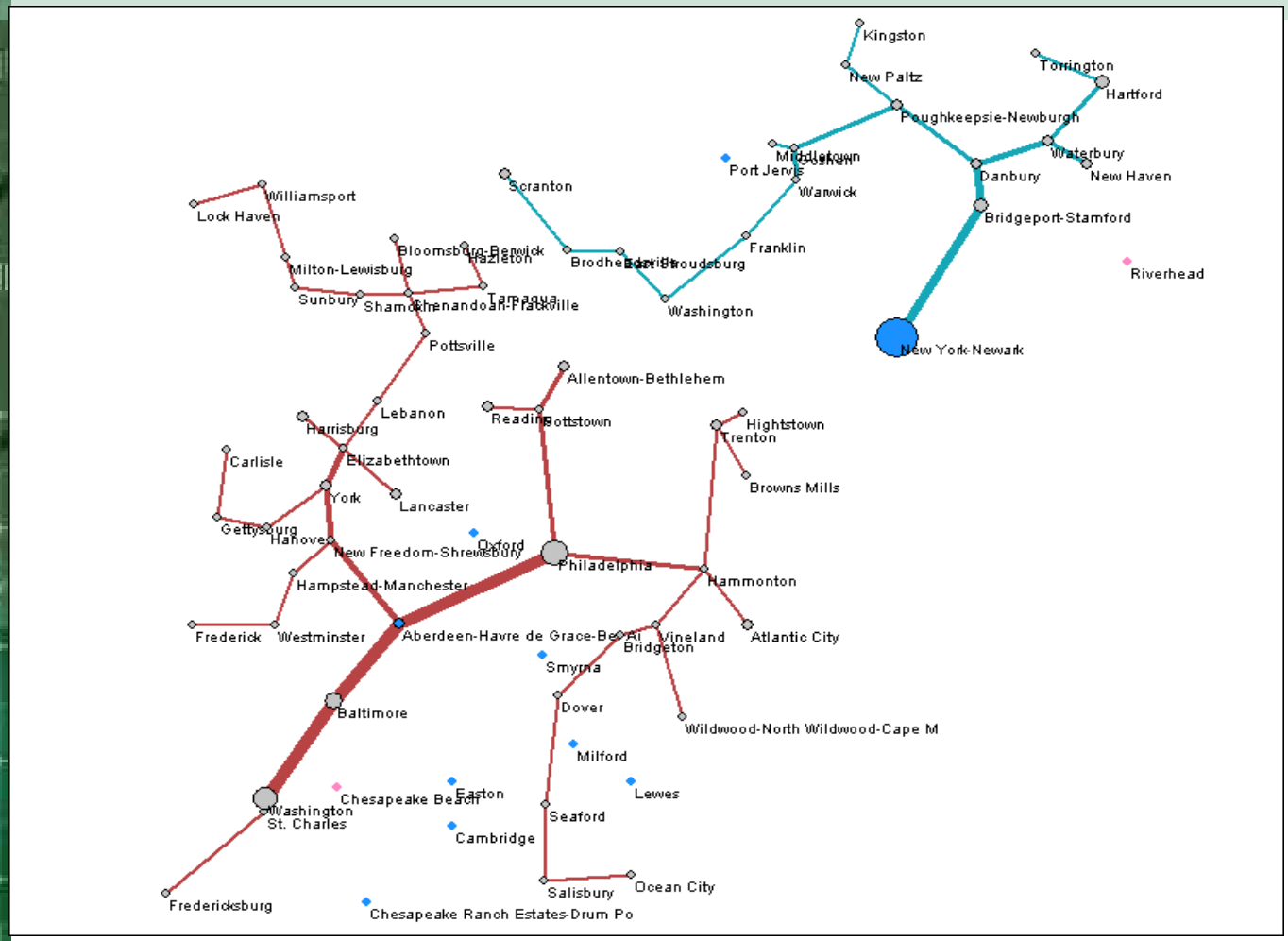



Isolante térmico
Vácuo
Isolante elétrico
Hidrogênio líquido 21K

Hydrogen Pipiline - USA

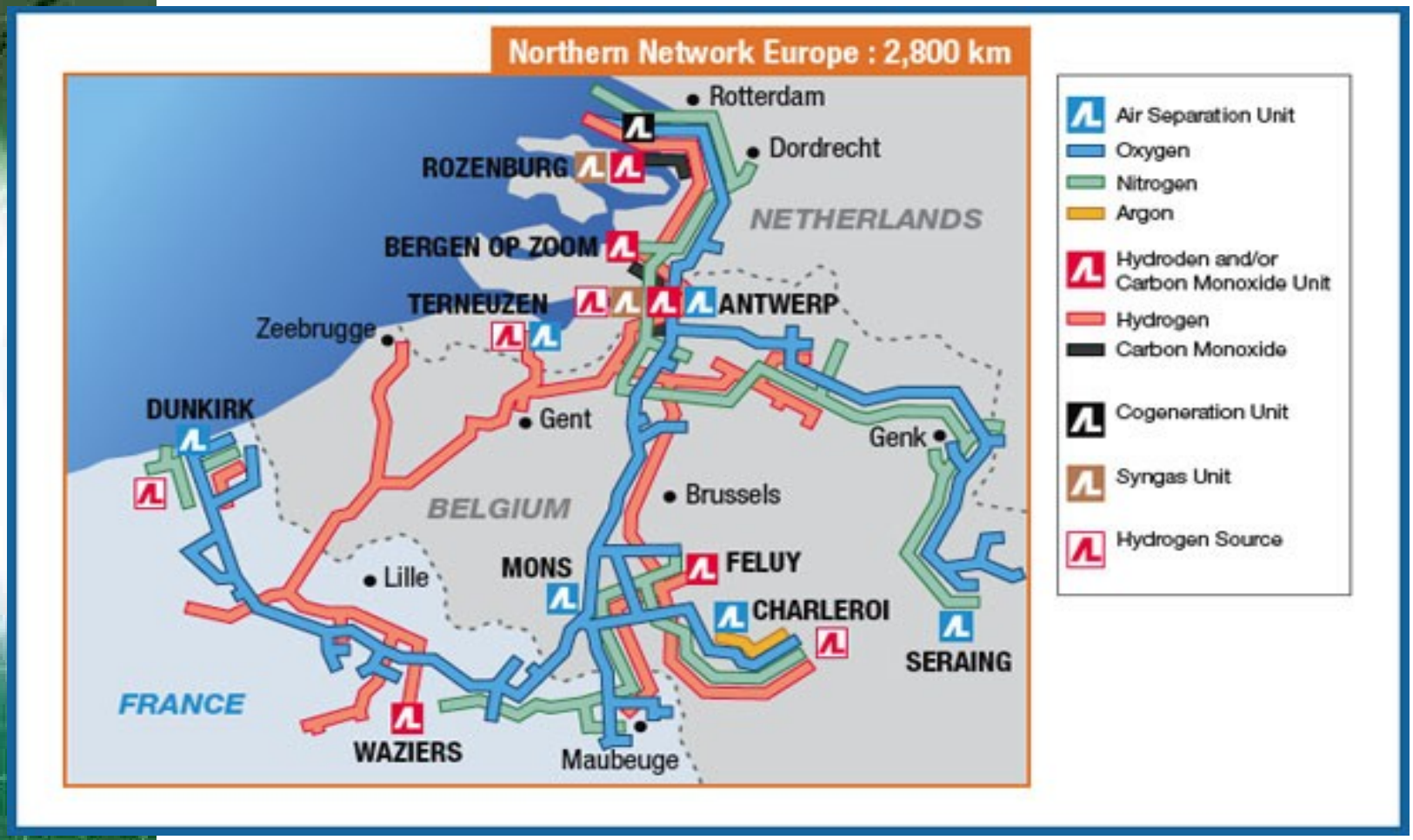
http://www.airliquide.com/en/our-offer/products/pipelines.html

Hydrogen Pipiline - USA



http://www.mistaya.ca/software/hynoon.htm

Hydrogen Pipiline - Belgica



http://www.air-liquideuk.co.uk/hydrogen/air-liquide-group/key-figures.html

Desafios: Distribuição

Inauguração do Posto de H2 em Berlim 24.05.2010

GRUPO ELECTROCELL® CÉLULAS A COMBUSTÍVEL

Posto de hidrogênio na Suécia – Stuart Energy

ISO - TC 197/WG 5 Gaseous hydrogen - Land vehicle filling connectors

Armazenamento de Hidrogênio

- Armazenamento como hidrogênio gasoso
- Armazenamento como hidrogênio líquido
- Armazenamento como compostos intermetálicos
  - Hidretos metálicos
- Nanotubos de carbono

Cilindro de alumínio revestido com fibra de carbono e resina

Mercado


Premium Power Market Entry Threshold
Automotive Market Entry Threshold
"OPPORTUNITY GAP"
$/kW
DataCom
Industrial Processes
Hospitals & Institutions
Small Commercial
Residential
Automotive
Year

Potential markets for Electrocell in Brazil

- **Back-up Energy for essential applications in the industry and service business**
- **Applications that need high quality energy**

1.000 Modern office buildings

43.961 - Mobile applications Antennas

5 to 10kW

263 Shoppings Centers

6.000 Hospitals and Chirurgic centers

1.291 ISPs and Datacenters

2MW back-up

159 Banks

270.000 Mainframes

GRUPO ELECTROCELL® CÉLULAS A COMBUSTÍVEL

Benefícios do Hidrogênio Renovável

- **Geral**
  - Hidrogênio renovável é produzido pelo combustível do local
  - Menor dependência de importação de combustíveis fóssil
  - Benefício à balança comercial
  - Fornece energia elétrica no local, sem perda na transmissão
- **Social**
  - Criação de empregos de qualidade em regiões rurais
  - Requalificação profissional para população local
  - Manutenção das pessoas em seus locais de origem
- **Econômico**
  - Diversificação e melhor renda em regiões basicamente agrárias
  - Melhoria da competitividade e de produtos de maior valor agregado
  - Desenvolvimento do setor de agronegócios e da economia em geral

Electrocell´s Next Generation Batteries

BIPOLAR PLATE BATTERY (Technical Superiority)

Tecnologia

- Possui 40% menos chumbo que a bateria convencional
- Durabilidade de 1.000 ciclos de carga / descarga a 100% DoD **(tradicional de Pb automotiva 100 ciclos).**

Meio Ambiente

- 100% Reciclável
- Se enquadra nos padrões ecológicos europeus

Economia e mercado

- Custo similar a Chumbo ácida convencional
- Mais leve (menor custo de transporte)
- Especificamente desenvolvida para energia fotovoltaicas e eólica
- Duas patentes depositadas, sendo uma delas também no exterior: Argentina, Chile, PCT mundial.
- Menor custo R$/Km

A Nova geração das Baterias




Electrocell´s Bipolar Plate Battery

High Energy - Medium Power
For EV (Electric Vehicle)

High Power - Medium Power
For PV (Photo Voltaic)

GROUP ELECTROCELL® FUEL CELL ENERGY

Parceiros Electrocell





cietec
Inovação e Empreendedorismo

Apoio
CNPq FAPESP FINEP

Parceiros Estratégicos

Ministério da Ciência e Tecnologia
BRASIL UM PAÍS DE TODOS
GOVERNO DO ESTADO DE SÃO PAULO
USP UNIVERSIDADE DE SÃO PAULO
ipen
ipt INSTITUTO DE PESQUISAS TECNOLÓGICAS
AES ELETROPAULO
ANEEL AGÊNCIA NACIONAL DE ENERGIA ELÉTRICA
Chesf
CEPEL CENTRO DE PESQUISAS DE ENERGIA ELÉTRICA
BGE
CEGASA INTERNACIONAL
SABÓ
IBG
BRATS FILTROS SINTERIZADOS PÓS METÁLICOS ESPECIAIS www.brats.com.br
CNZ
DCSYSTEM
ADTS SOLUÇÕES EM TELEMETRIA
Anodarc Revestimentos especiais
Adespec Adesivos Especiais Verde de verdade!
Khemia EQUIPAMENTOS TECNOLÓGICOS DE EFLUENTES
GLOBALMAG
HIGHCOMM
IBASIL TECNOLOGIA
INNOVATECH
LaserTools.com.br soluções a laser
MAMUTE MÍDIA web multimídia e-learning
op2b Otimização para Negócios
SOCIEDADE DO SOL

Congresso Internacional de Hidrogênio - Alemanha - WHIC/ Essen – 24.05.10

Congresso Internacional de Hidrogênio - Alemanha / WHICH Essen – 24.05.10

INMETRO

GRUPO ELECTROCELL® CÉLULAS A COMBUSTÍVEL

Congresso Internacional de Hidrogênio - Alemanha / Essen – 24.05.10

Submarino

Submarino U 31 classe 212, em teste no mar Baltico

A Siemens forneceu as células para o U 31 - submarino alemão e para o submarino Grego da classe 209, com opção para 40 unidades de células do tipo PEM

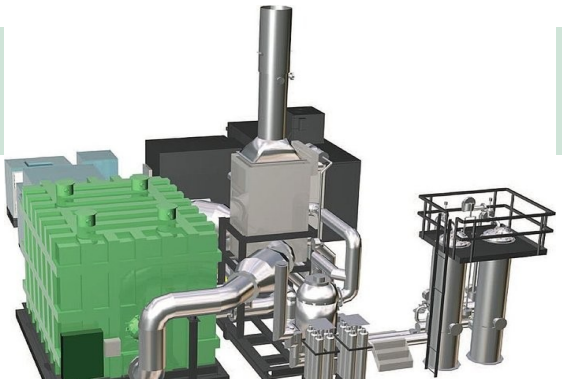
Projeto desenvolvido por Howaldtswerke-Deutsche Werft AG

Unidades de 1MW

(Above) This tractor-trailer-sized generator from Ballard produces 1 MW of additional power using hydrogen fuel cells. FirstEnergy Generation Corp., Ohio, U.S.A., is installing the unit to provide peak power in Eastlake, Ohio, for a five-year trial. (Right) The fuel cell system comprises nine modified bus fuel cell modules arranged in three banks of three.

Custo instalação: Aprox.1000USD/kW

2,8MW
a 4,6MW



Performance

Power Output	
Power @ Plant Rating	2,800 kW
Standard Output AC Voltage	13,800 V
Standard Frequency	60 Hz
Optional Output AC Voltages	12,700, 4,160 V
Optional Output Frequency	50 Hz
Efficiency	
LHV	47 +/- 2 %
Available Heat	
Exhaust Temperature	700 +/- 50 °F
Exhaust Flow	36,600 lb/h
Allowable Backpressure	5 iwc
Heat Energy Available for Recovery (to 250°F) 4,433,000 Btu/h (to 120°F) 7,460,000 Btu/h	
Fuel Consumption	
Natural gas (at 930 Btu/ft³)	362 scfm
Heat Rate, LHV	7,260 BTU/kWh

Water Consumption	
Average	9 gpm
Peak during WTS backflush	30 gpm
Water Discharge	
Average	4.5 gpm
Peak during WTS backflush	30 gpm
Pollutant Emissions	
NOx	0.01 lb/MWh
SOx	0.0001 lb/MWh
PM10	0.00002 lb/MWh
Greenhouse Gas Emissions	
CO_2	980 lb/MWh
CO_2 (with waste heat recovery)	520-680 lb/MWh
Sound Level	72 dB(A) at 10 feet

http://www.fuelcellenergy.com

Desenvolvimento das Normas Técnicas de Hidrogênio na ABNT e na ISO.

- ABNT (www.abnt.org.br)
- ISO (www.iso.org) – Membro Permanente
- IEC – Membro Observador

ISO

ISO Subcommittee/Working Group	Title Hydrogen technologies
TC 197/WG 5	Gaseous hydrogen - Land vehicle filling connectors
TC 197/WG 6	Gaseous hydrogen and hydrogen blends - Land vehicle fuel tanks
TC 197/WG 8	Hydrogen generators using water electrolysis process
TC 197/WG 9	Hydrogen generators using fuel processing technologies
TC 197/WG 10	Transportable gas storage devices - Hydrogen absorbed in reversible metal hydride
TC 197/WG 11	Gaseous hydrogen - Service stations
TC 197/WG 12	Hydrogen fuel - Product specification
TC 197/WG 13	Hydrogen detectors
TC 197/WG 14	Hydrogen fuel - Product Specification - Proton exchange membrane (PEM) fuel cell applications for stationary appliances
TC 197/WG 15	Gaseous hydrogen - Cylinders and tubes for stationary storage

IEC

IEC Working Group :
WG 1 - Terminology
WG 2 - Fuel cell modules
WG 3 - Stationary fuel cell power systems - Safety
WG 4 - Performance of Fuel Cell Power Systems
WG 5 - Stationary Fuel Cell Power Systems - Installation
WG 6 - Fuel cell system for propulsion and auxiliary power units (APU)
WG 7 - Portable fuel cell power systems - Safety
WG 8 - Micro fuel cell power systems - Safety
WG 9 - Micro fuel cell power systems - Performance
WG 10 - Micro fuel cell power systems - Interchangeability
WG 11 - Fuel cell technologies - Part 7-1: Single Cell Test Method for Polymer Electrolyte Fuel Cell (PEFC)
WG AHG1 - Identification of the market needs for standardization work on fuel cell systems for propulsion and auxiliary power units

INMETRO

GRUPO ELECTROCELL® CÉLULAS A COMBUSTÍVEL

CEE-67 (Membros – 24 instituições e 42 pessoas) – 5 anos

ABNT	Alvaro Almeida	Claudio Guerreiro	Eduardo Lima	Victor Jardim	
ABNT/CB-03	Martin Crnugelj				
ABNT/CB-50	Arlindo Lima Charbel				
ANP	George Rodrigues da Silva	Pedro Henrique Lemmers			
CEMIG	Andre Martins Carvalho				
CNEH / UNICAMP	Newton Pimenta Neves Jr	Cristiano Silva Pinto			
COPPE	Paulo Emílio V. de Miranda				
CPqD	M. Fátima N. C. Rondem	Luiz Eduardo F. Dias C	Maria do Rosário Hurtado		
ELECTROCELL	Gerhard Ett				
EMTU	Marcio Schetino				
EPE	Janaina Francisco Sala				
INMETRO	Sérgio Pinheiro de Oliveira	Adriana da Cunha Rocha	Jorge Troca Filho		
INT	Claudio Maris Ferreira	Maria Conceição Greca Marinho	Vera Lucia Maia Lellis		
IPEN	Angelo Massatoshi Ebesui	Adonis M. Saliba Silva			
IPT	João Guilherme R. Poço				
LACTEC	Mauricio Cantão				
MCT	Adriano Duarte Fº				
MME	Symone C. S. Araújo				
Novocell	Valdemar Stelita				
PETROBRAS	Newton Reis de Moura	Pedro Villalobos	Hani Hussein Aly El Sharawy	Oscar Felizzola Souza	Patrícia Costa Gonzalez de Nunes
UENF	Herval Ramos Paes Jr				
UFMG	Rosana Zacarias	Marcia Caldeira Brant N			

NORMAS de HIDROGÊNIO e Células a Combustível em 2010

1. ABNT IEC/TS 62282-1:2009
Terminologia

2. ABNT ISO/TR 15916:2010
Considerações básicas para a segurança dos sistemas de hidrogênio

3. ABNT NBR ISO 14687-1:2010
Combustível de hidrogênio – Especificação do produto
Parte 1: Todas as aplicações, exceto células a combustível de membrana de troca de prótons (PEM) para veículos rodoviários automotores

4. ABNT NBR ISO 16110-1:2010
Geradores de hidrogênio que utilizam tecnologias de processamento de combustível
Parte 1: Segurança

5. ABNT NBR ISO 17268:2010
Dispositivos de conexão para reabastecimento de veículos terrestres com hidrogênio comprimido

6. ABNT NBR IEC 62282-2: 2010
Tecnologia de Célula a Combustível - Parte 2

Previsão - elaboração 5 para 2011

Thank you for your time!

Wellcome to ELECTROCELL!

Gerhard Ett

Diretor Electrocell
gerhard@electrocell.com.br
Tel: (+55 11) 3039-8321 / 8322 / 8333
www.electrocell.com.br

Coordenador ABNT - CB67 -
Tecnologia do Hidrogênio e Células a combustível
www.abnt.org.br

Brasil 2018