

WORKSHOP

FAPESP – THE RESEARCH COUNCIL OF NORWAY

ENERGY FOR THE FUTURE
September 21, 2016



Research Centre
for Gas Innovation

RCGI RESEARCH CENTRE FOR GAS INNOVATION

CLEANER ENERGY FOR A SUSTAINABLE FUTURE



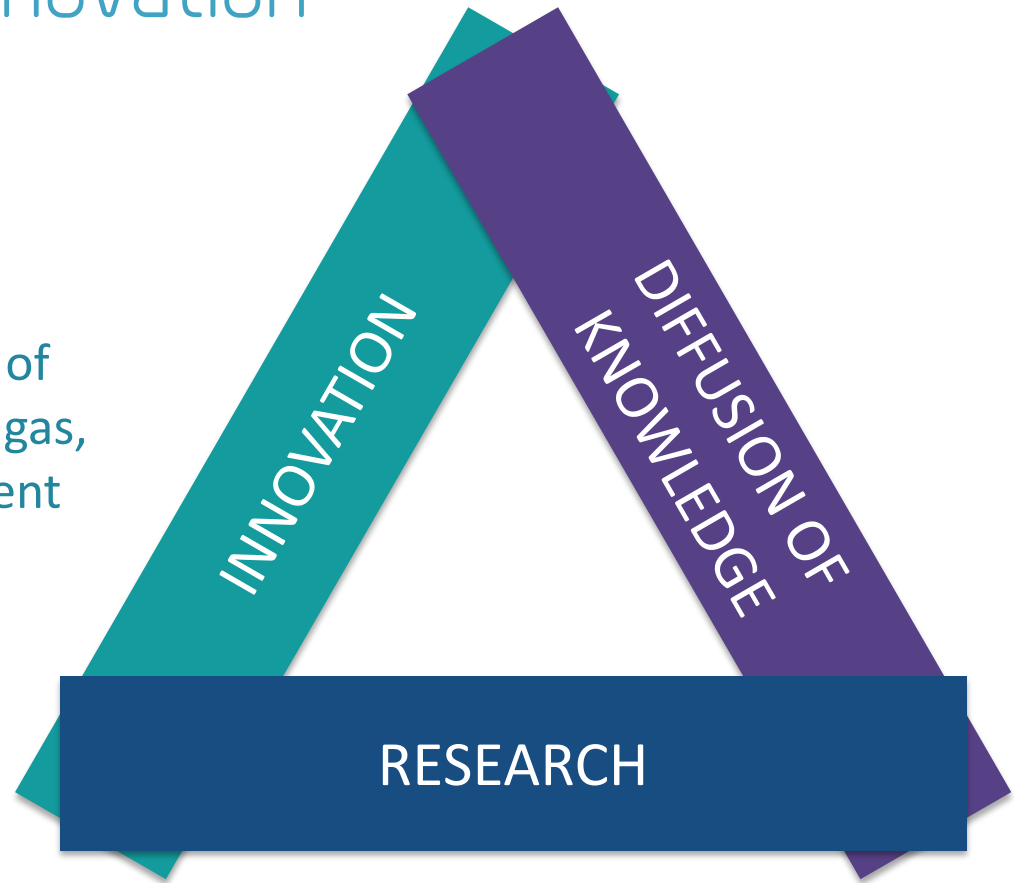
Research Centre
for Gas Innovation



Research Centre for Gas Innovation

Cleaner energy for a sustainable future

A centre for advanced studies of
the sustainable use of natural gas,
biogas, hydrogen and abatement
of CO2 emissions



Industry-Academy Interaction: TT and DoK

- **Building a concrete knowledge:**

the necessity of infra-structure and laboratories

- **Recent Publications:**

Technology-Transfer and Diffusion of Knowledge

- **Past experience, some few examples:**

Vortex-induced Vibration (VIV) on Risers, Drag Reduction Devices, and Aeroacoustics

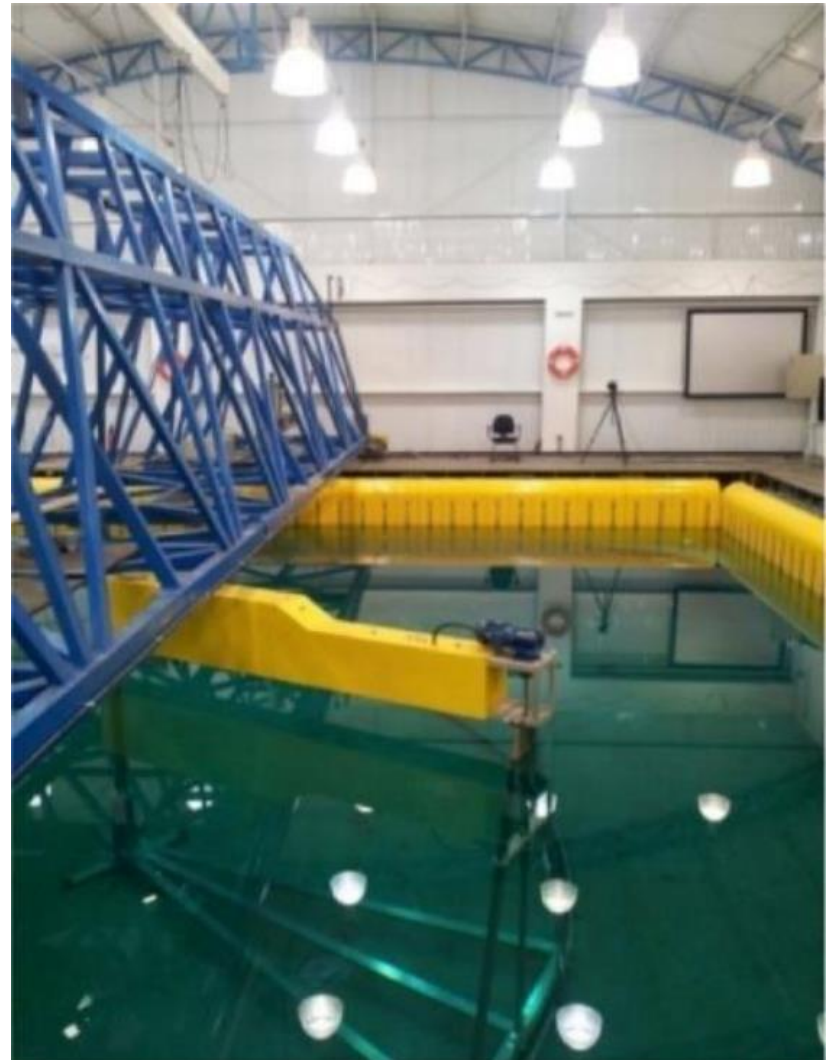
Laboratory of Environmental and Thermal Engineering - LETE



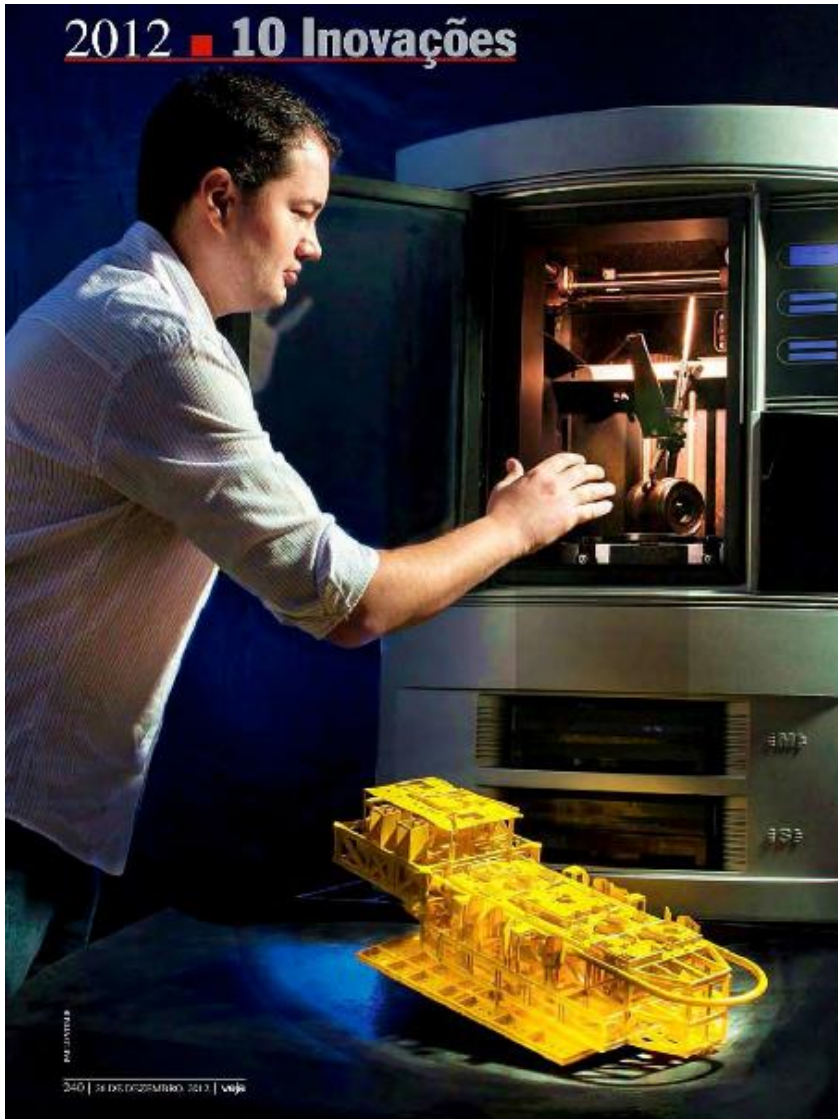
Fluid & Dynamics Research Group - NDF



Numerical Wave Tank - TPN



2012 ■ 10 Inovações



Some recent "publications": Technology Transfer from Academy to the Industry and Diffusion of Knowledge

*"Veja" Magazine, 22 Dec 2012, Prototype Machine:
Manifolds and Landing Gears, Gustavo Assi, NDF*

Experimental investigation of flow-induced vibration on isolated and tandem circular cylinders fitted with strakes[☆]

I. Korkischko*, J.R. Meneghini

NDF, Department of Mechanical Engineering, POLI, University of São Paulo, Brazil

Received 3 April 2009; accepted 25 February 2010
Available online 15 April 2010

Journal of Fluids and Structures 34 (2012) 259–270



Contents lists available at SciVerse ScienceDirect

Journal of Fluids and Structures

journal homepage: www.elsevier.com/locate/jfs



Suppression of vortex-induced vibration using moving surface boundary-layer control

I. Korkischko, J.R. Meneghini*

NDF, Department of Mechanical Engineering, POLI, University of São Paulo, Brazil

PHYSICS OF FLUIDS 22, 054101 (2010)

Possible states in the flow around two circular cylinders in tandem with separations in the vicinity of the drag inversion spacing

B. S. Carmo,^{1,2,a)} J. R. Meneghini,^{2,b)} and S. J. Sherwin^{1,c)}

¹Department of Aeronautics, Imperial College, London SW7 2AZ, United Kingdom

²Department of Mechanical Engineering, NDF, University of São Paulo, Poli, São Paulo 05508-900, Brazil

(Received 2 October 2009; accepted 29 March 2010; published online 4 May 2010)

The possible states in the flow around two identical circular cylinders in tandem arrangements are investigated for configurations in the vicinity of the drag inversion separation. By means of numerical simulations, the hysteresis in the transition between the shedding regimes is studied and the relationship between (three-dimensional) secondary instabilities and shedding regime determination is addressed. The differences observed in the behavior of two- and three-dimensional flows are analyzed, and the regions of bistable flow are delimited. Very good agreement is found between the proposed scenario and results available in the literature. © 2010 American Institute of Physics. [doi:10.1063/1.3420111]

J. Fluid Mech. (2010), vol. 644, pp. 395–431. © Cambridge University Press 2010
doi:10.1017/S0022112009992473

395

Secondary instabilities in the flow around two circular cylinders in tandem

BRUNO S. CARMO^{1,†}, JULIO R. MENEGHINI²
AND SPENCER J. SHERWIN¹

¹Department of Aeronautics, Imperial College London, South Kensington Campus,
London SW7 2AZ, UK

²NDF, Department of Mechanical Engineering, Poli, University of São Paulo, SP, Brazil

(Received 30 March 2009; revised 23 September 2009; accepted 24 September 2009)

J. Fluid Mech., page 1 of 37 © Cambridge University Press 2010

doi:10.1017/S0022112010003095

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On the wake-induced vibration of tandem circular cylinders: the vortex interaction excitation mechanism

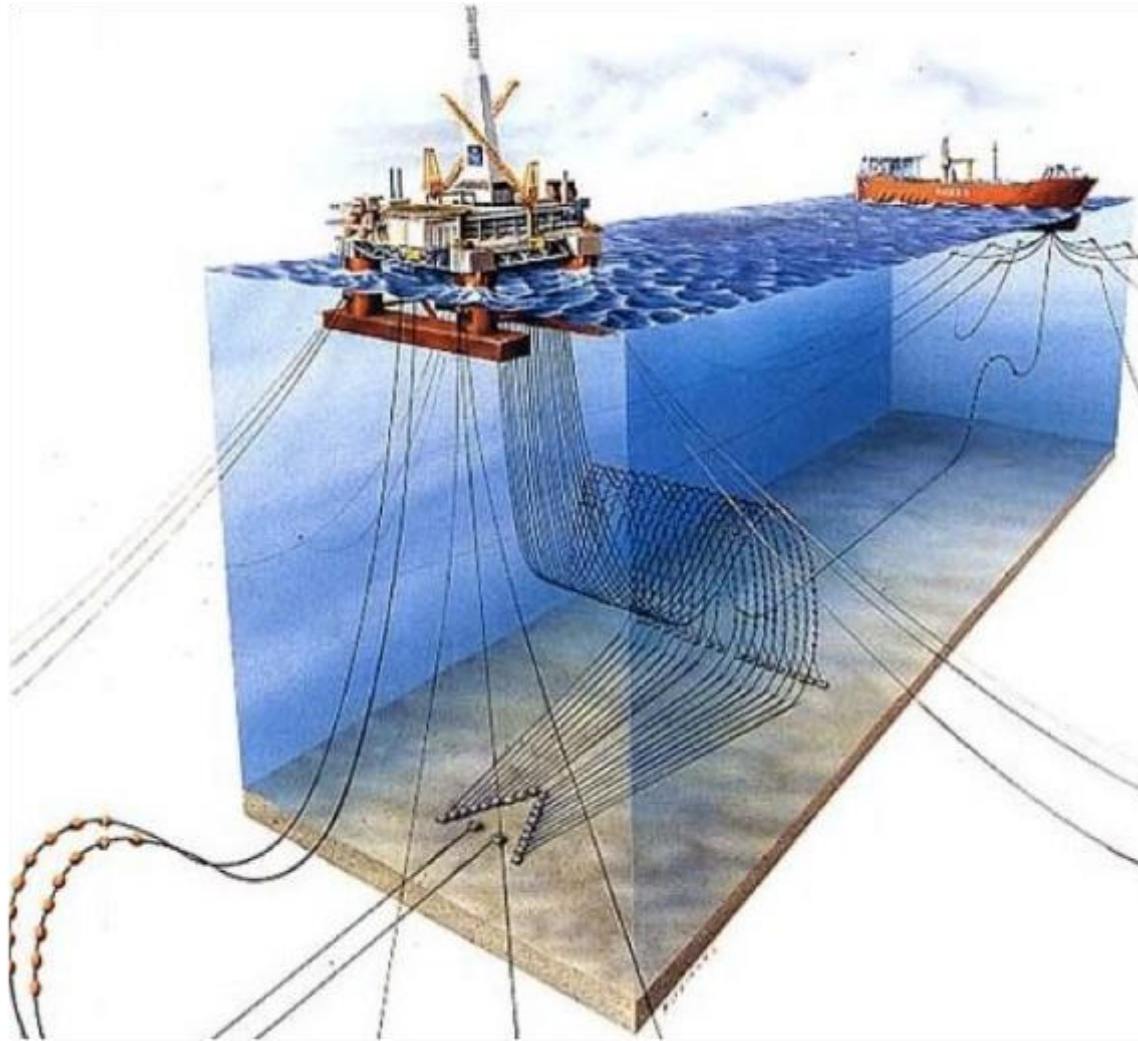
G. R. S. ASSI^{1,†}, P. W. BEARMAN¹ AND J. R. MENEGHINI²

¹Department of Aeronautics, Imperial College, London SW7 2AZ, UK

²Department of Mechanical Engineering, NDF, POLI, University of São Paulo,
São Paulo, 05508-900, Brazil

(Received 28 October 2009; revised 25 May 2010; accepted 1 June 2010)

Motivation 1: VIV on Risers and Oil and Gas Transport Ships



Moving Boundary Surface Concept for VIV Suppressor and Drag Reduction Device: Ivan Korkischko and Julio R Meneghini, JFS 2010

Carmo et al. 2010, Ássi et al. 2010,

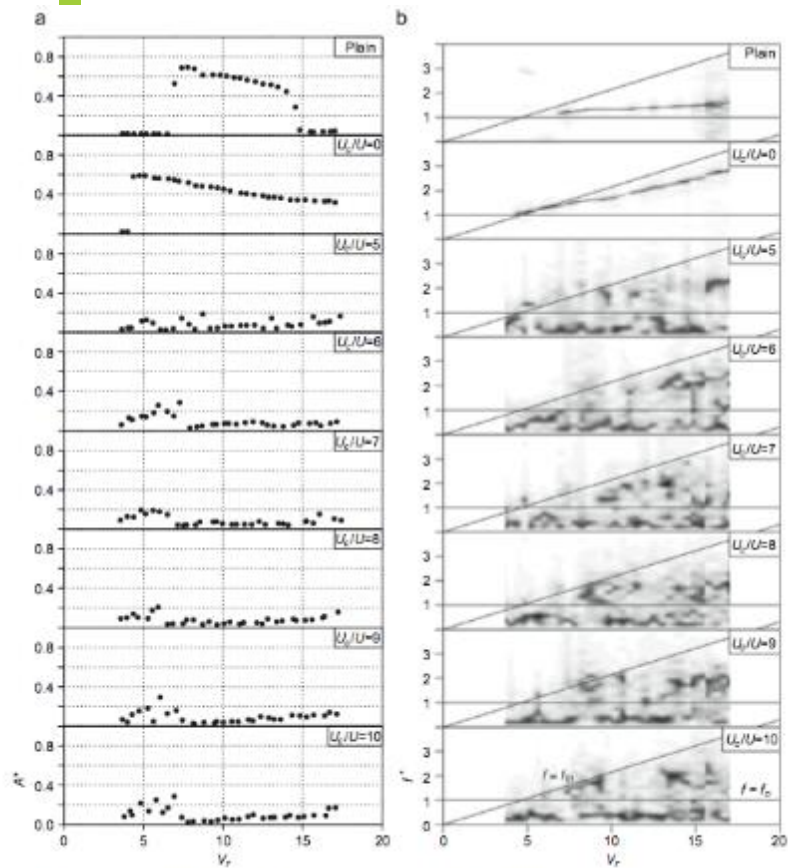


Fig. 2. Amplitude and frequency responses of isolated circular cylinders with and without MSBC ($Re = 1600 - 7500$, $d_c/d = 0.06$ and $g/d = 0.07$). (a) Amplitude response and (b) frequency response: PSD² contour plot.

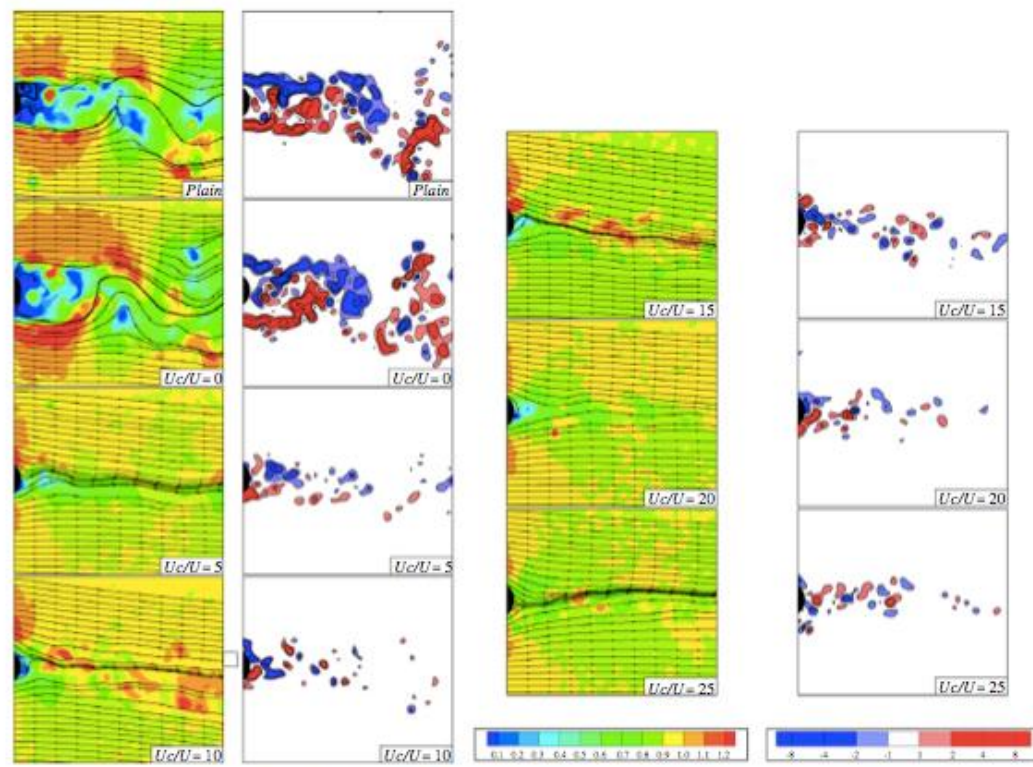


Fig. 4. Nondimensional instantaneous fields of velocity magnitude (left) and vorticity ω_z^* (right) of circular cylinders with and without MSBC ($Re = 3000$, $d_c/d = 0.06$ and $g/d = 0.07$).

Moving Boundary Surface Concept for VIV Suppressor and Drag Reduction Device: Ivan Korkischko and Julio R Meneghini, 2010 PATENT PENDING

I. Korkischko, J.R. Meneghini / Journal of Fluids and Structures 34 (2012) 259–270

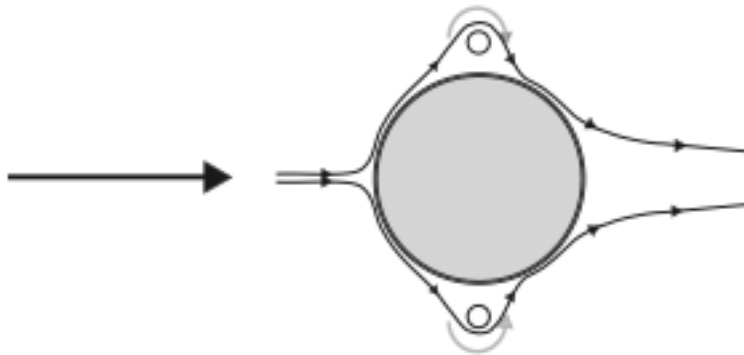
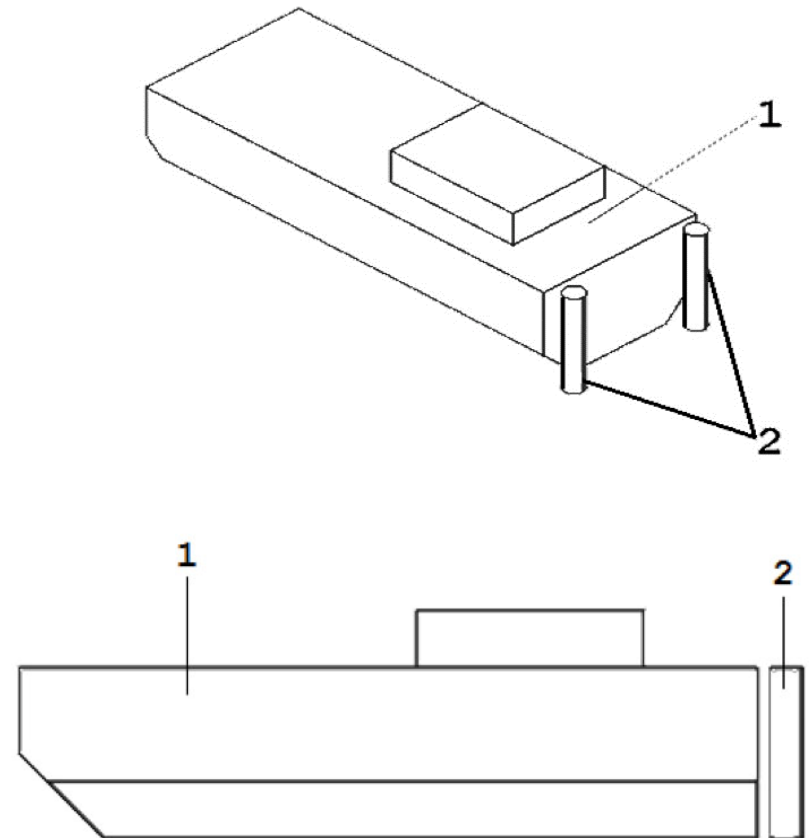
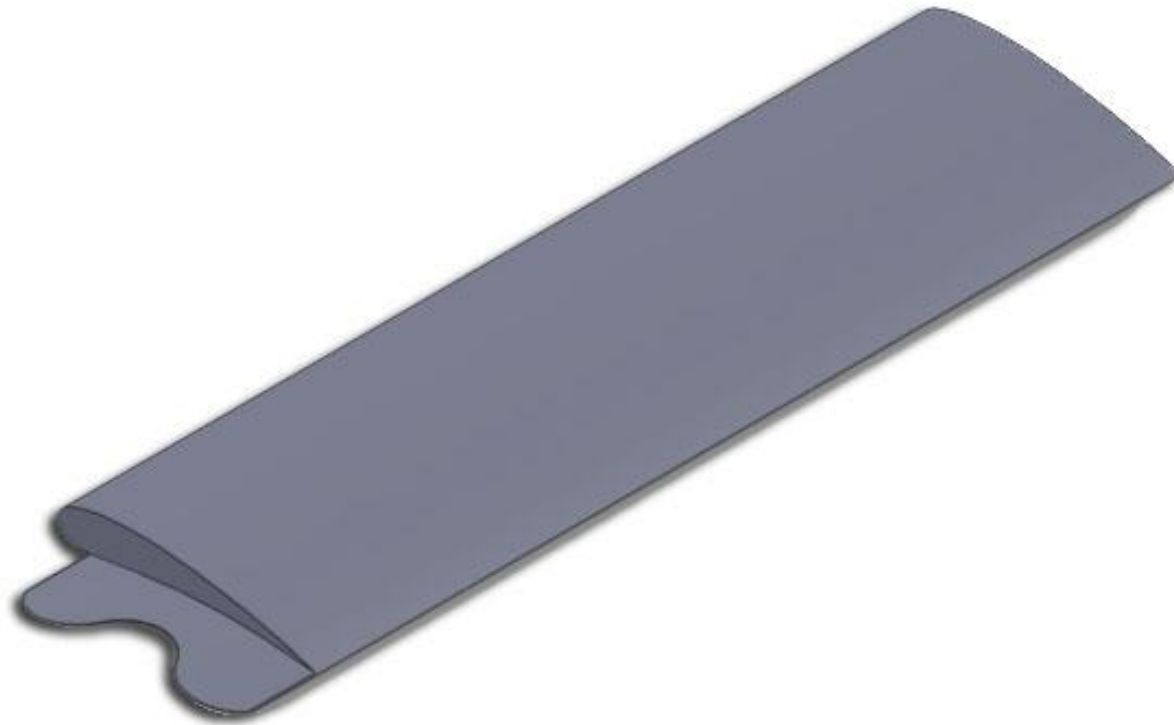


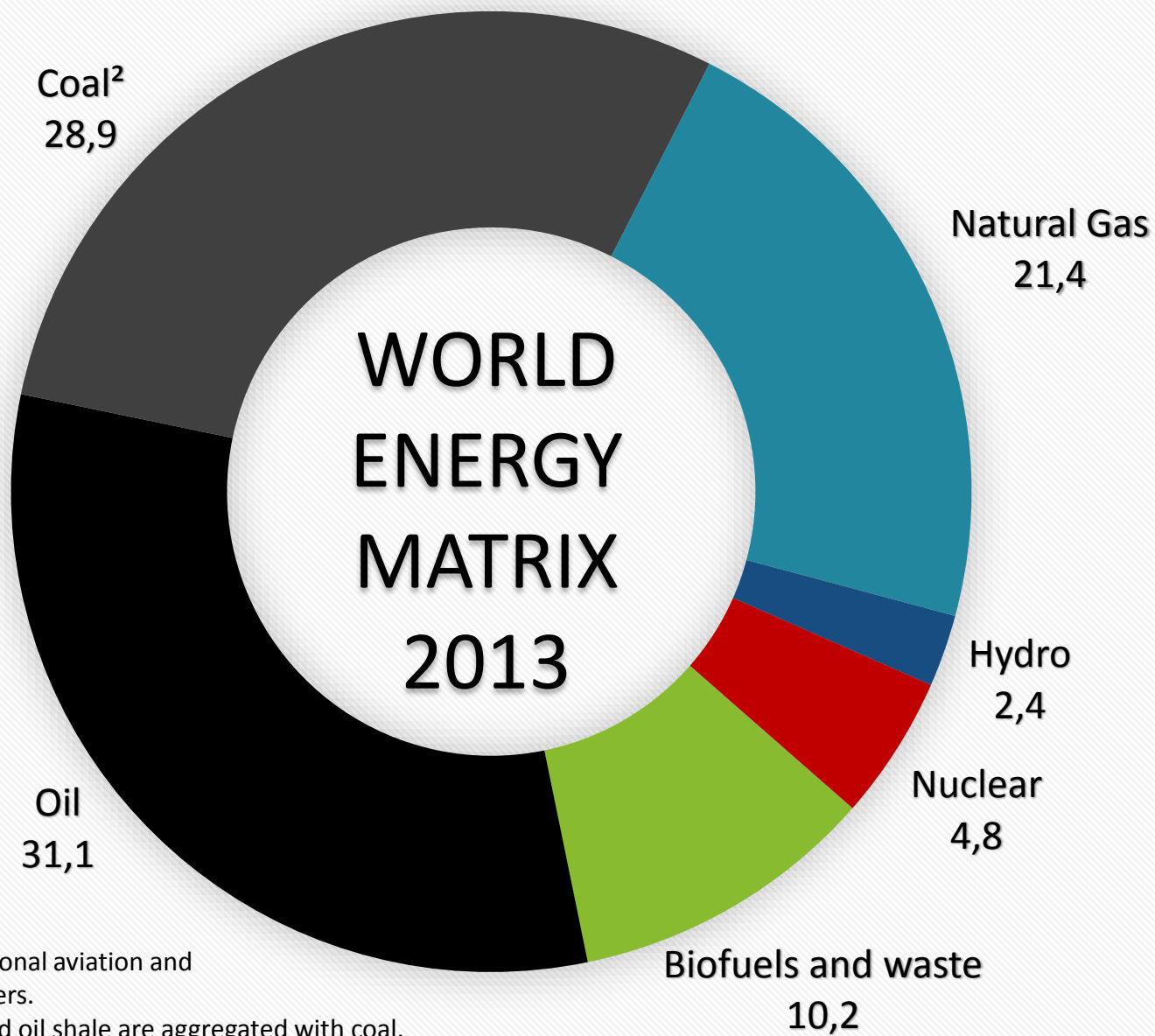
Fig. 8. Schematic of the flow around the circular cylinder with MSBC.



USA Patent Pending

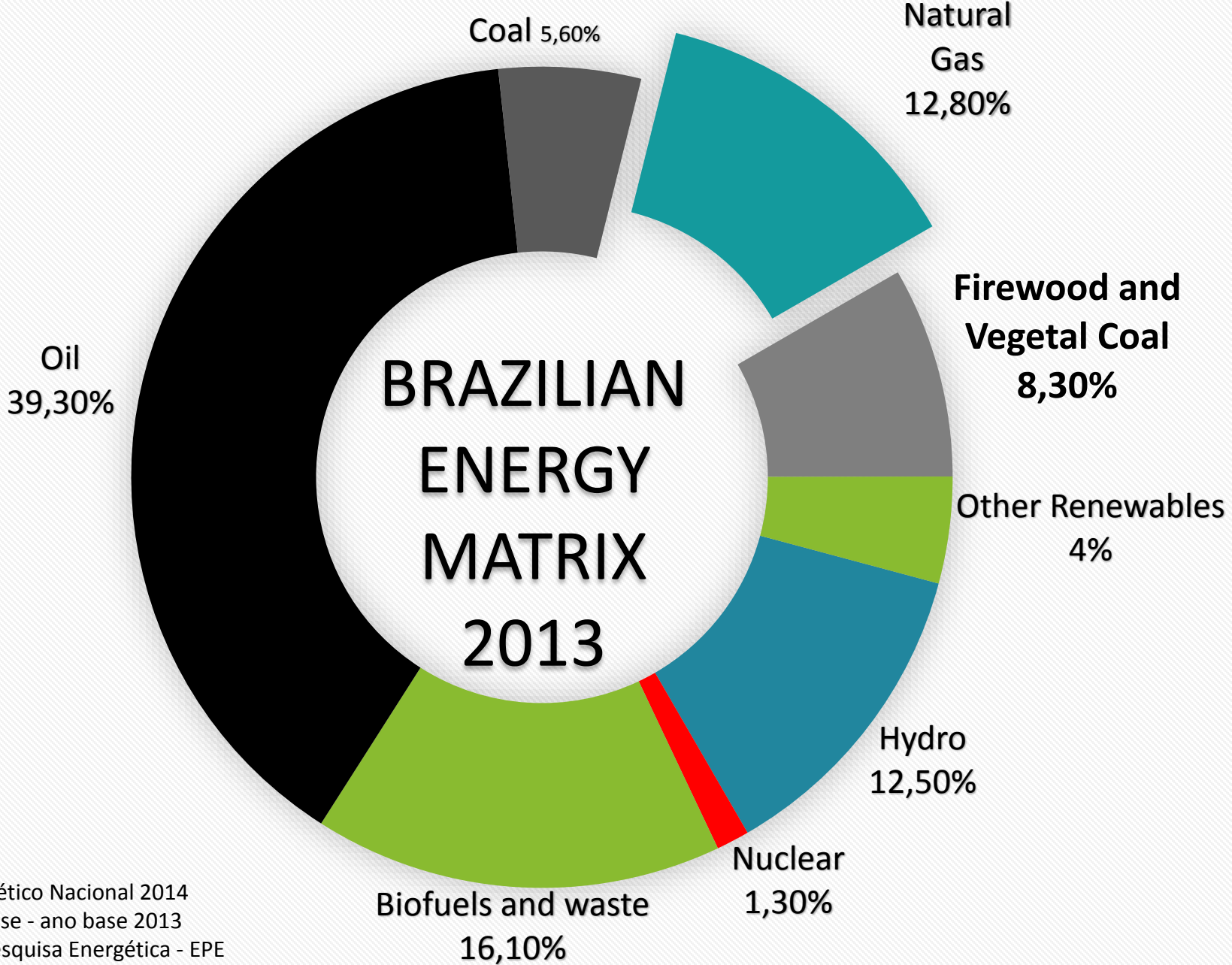


Natural Gas, Biogas, Hydrogen and Abatement of CO₂ Emissions



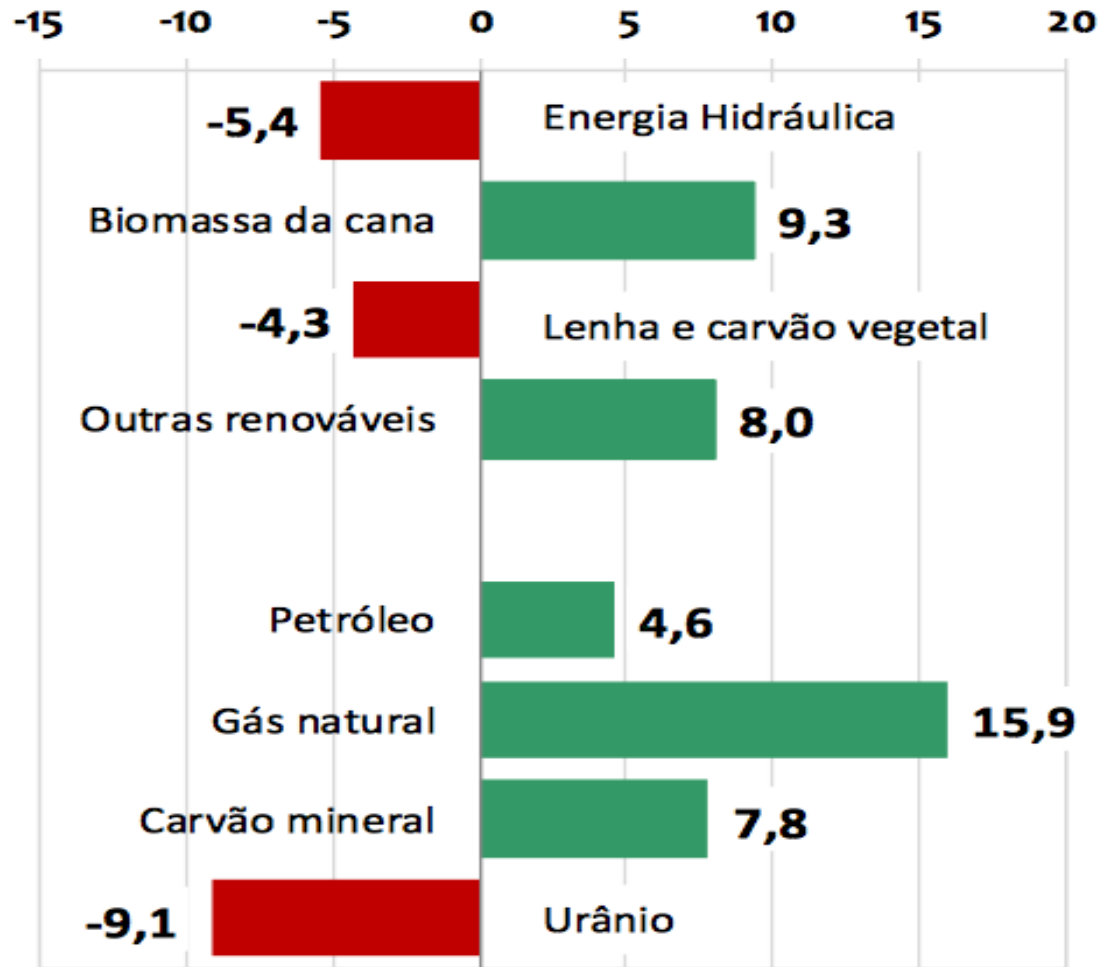
1. World includes international aviation and international marine bunkers.

2. In these graphs, peat and oil shale are aggregated with coal.




Balanco Energético Nacional 2014
Relatório Síntese - ano base 2013
Empresa de Pesquisa Energética - EPE

variação % 2013/2012



Balço Energético Nacional 2014
Relatório Síntese - ano base 2013
Empresa de Pesquisa Energética - EPE



Campos Basin:
NG reserve
2,1billion boe

BRAZIL:
NG production record:
Dec 2015
100,4 million m³/day



The RCGI

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BG GROUP



PARTICIPANT INSTITUTIONS



RCGI IN NUMBERS

150 researchers



28 initial projects



3 programmes



Scholarship opportunities



PROGRAMMES AND PROJECTS

Engineering Programme
Projects 1 to 10



Physical-Chemistry Programme
Projects 11 to 20



Economics & Energy Policies Programme
Projects 21 to 28



ENGINEERING PROGRAMME



- Project 1 - Development of an advanced natural gas burner using the oxy-fuel concept
- Project 2 - Laboratory of advanced combustion diagnostics
- Project 3 - Advanced systems for the use of mixed gas and diesel in internal combustion engines for methane emission mitigation
- Project 4 - Feasibility/design of efficient and environmentally friendly ship concepts with natural gas as fuel
- Project 5 - Design and optimization of storage systems by adsorption for natural gas
- Project 6 - Optimization based on the adjoint method for natural gas storage systems
- Project 7 - Hybrid power systems for ships
- Project 8 - Modeling and numerical simulation
- Project 9 - Studies of the application of laser (LIDAR) for atmospheric pollution measurements
- Project 10 - Optimized labyrinth seals

PHYSICAL-CHEMISTRY PROGRAMME



Project 11 - Development of an Advanced Natural Gas Burner using the Flameless Concept

Project 12 - Advancing fuel cells for operation on natural gas

Project 13 - Synthesis gas production by methane tri-reforming

Project 14 - Methanol production by CO₂ hydrogenation

Project 15 - Advanced Catalyst for Fischer-Tropsch Synthesis

Project 16 - A hybrid solar-gas system for natural gas steam reforming

Project 17 - Converting biogas to bioproducts

Project 18 - Microbial production of polyhydroxybutyrate (PHB) from methane (CH₄)

Project 19 - Structured ceramic membrane for separation of CH₄ / CO₂

Project 20 - Supported metal nanoparticles as catalyst for the PROX reaction

ECONOMICS & ENERGY POLICIES PROGRAMME



Project 21 - Creation of the Brazilian and São Paulo Legal Service of Natural Gas

Project 22 - Producing studies "benchmark" about the efficient use of natural gas in the industrial sector

Project 23 - Brazilian inventory of greenhouse gases and scenarios for reducing emissions related to natural gas

Project 24 - Estimation of price elasticities and income of Natural Gas in Brazil

Project 25 - Natural Gas sustainability of Integrated Analysis as a transportation fuel in heavy vehicles: the Blue Corridor Paulista

Project 26 - Evaluation of small LNG and CNG drives as options for the supply, transmission and distribution in Brazil

Project 27 - The Biomethane's contribution prospects to increase the supply of Natural Gas

Project 28 - GEODIS: integrated and dispersed energy planning systems geographically for Natural Gas

NEW PROPOSALS



Project 29 - Development of an Hybrid Penta-fuel Flex Vehicle advanced natural

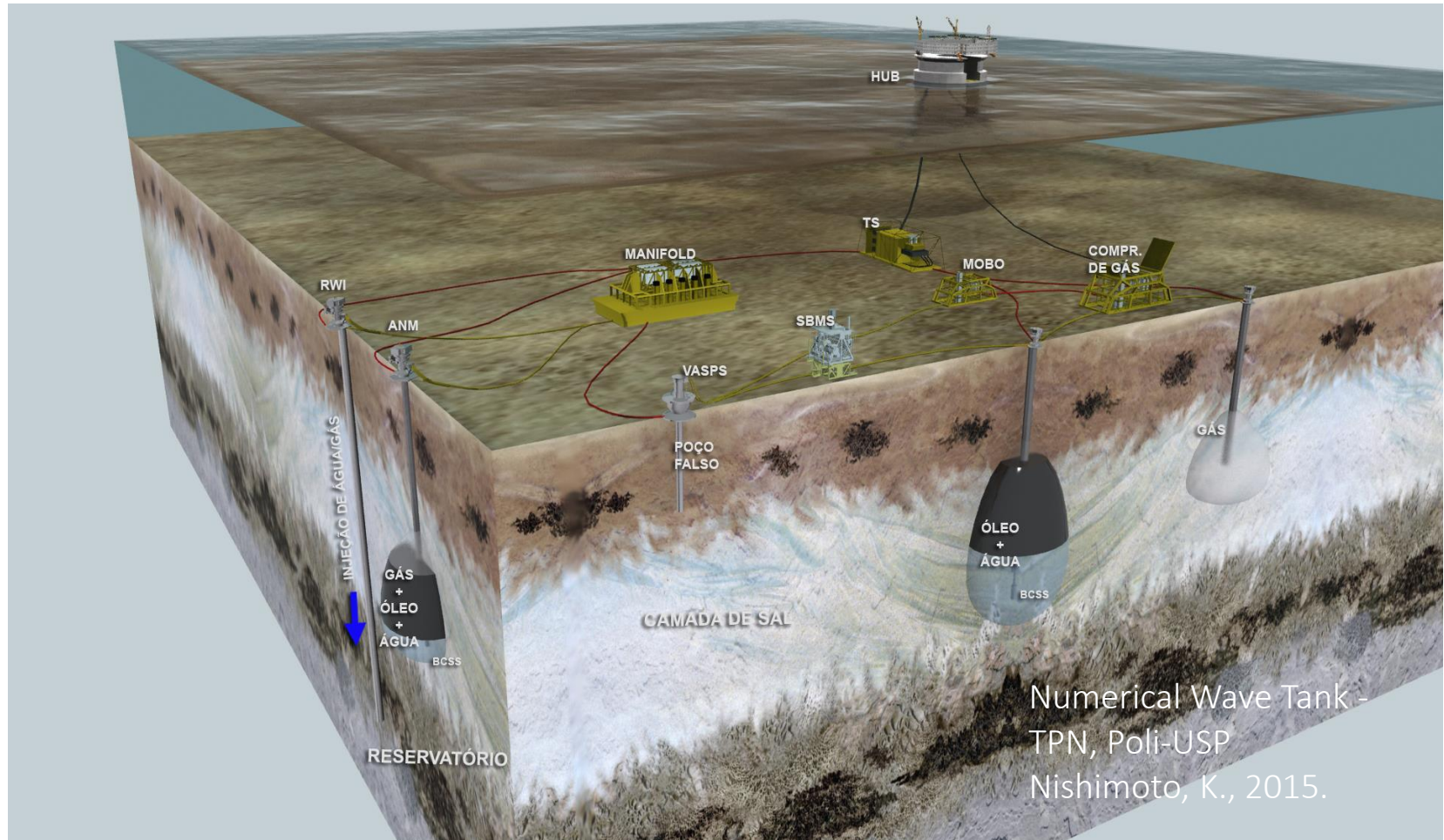
Project 30 – Assembly and Development of an Hydrogen Articulated Bus and Vehicular Hydrogen Station (Natural and Biogas Reform with Solar Concentrators (BNDES-COMGAS-EMTU-Secretary of Energy of São Paulo State)

Project 31 – Bio-digesters for Vinasse and Bagasse from Ethanol Plants with Solar Energy Concentrators, Membranes and Compact CO₂/CH₄ Separators: Production of Biogas to substitute Diesel

Project 32 – Offshore Hub for Electricity Generation: GTW concept, CCS, Compact Separators and FLNG (Oil Industry Consortium)

Project 33 – A case study for the use of Natural Liquefied Natural Gas to substitute Diesel for Mine Trucks (VALE-SHELL)

NEW PROPOSALS



Numerical Wave Tank -
TPN, Poli-USP
Nishimoto, K., 2015.



Research Centre for Gas Innovation

cleaner energy for a sustainable future



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