



Roadmap do Mercado Brasileiro de
VEÍCULOS PESADOS A GNV

Brazil Roadmap for Natural Gas and Biomethane Heavy Duty Trucks & Buses

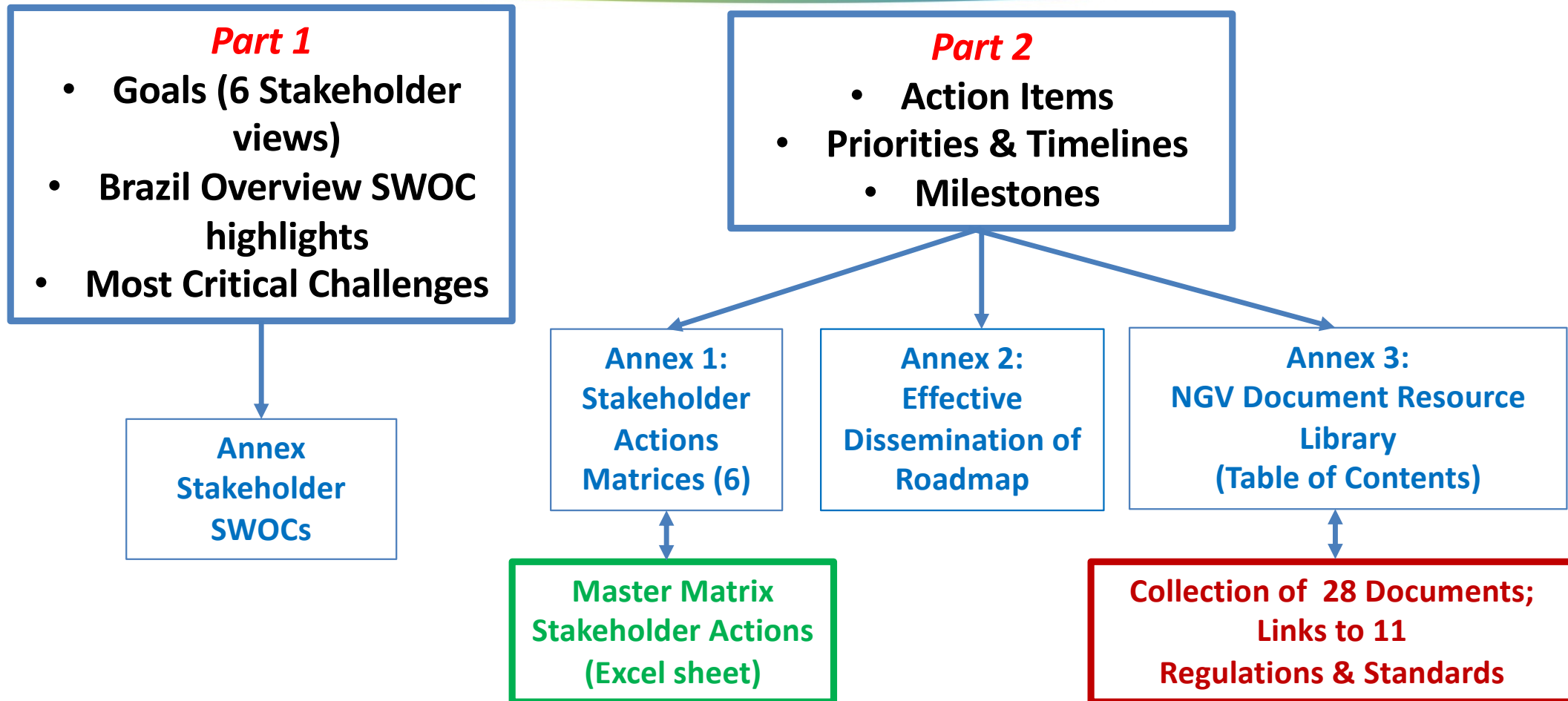
Part 2

ACTIONS

July 2021

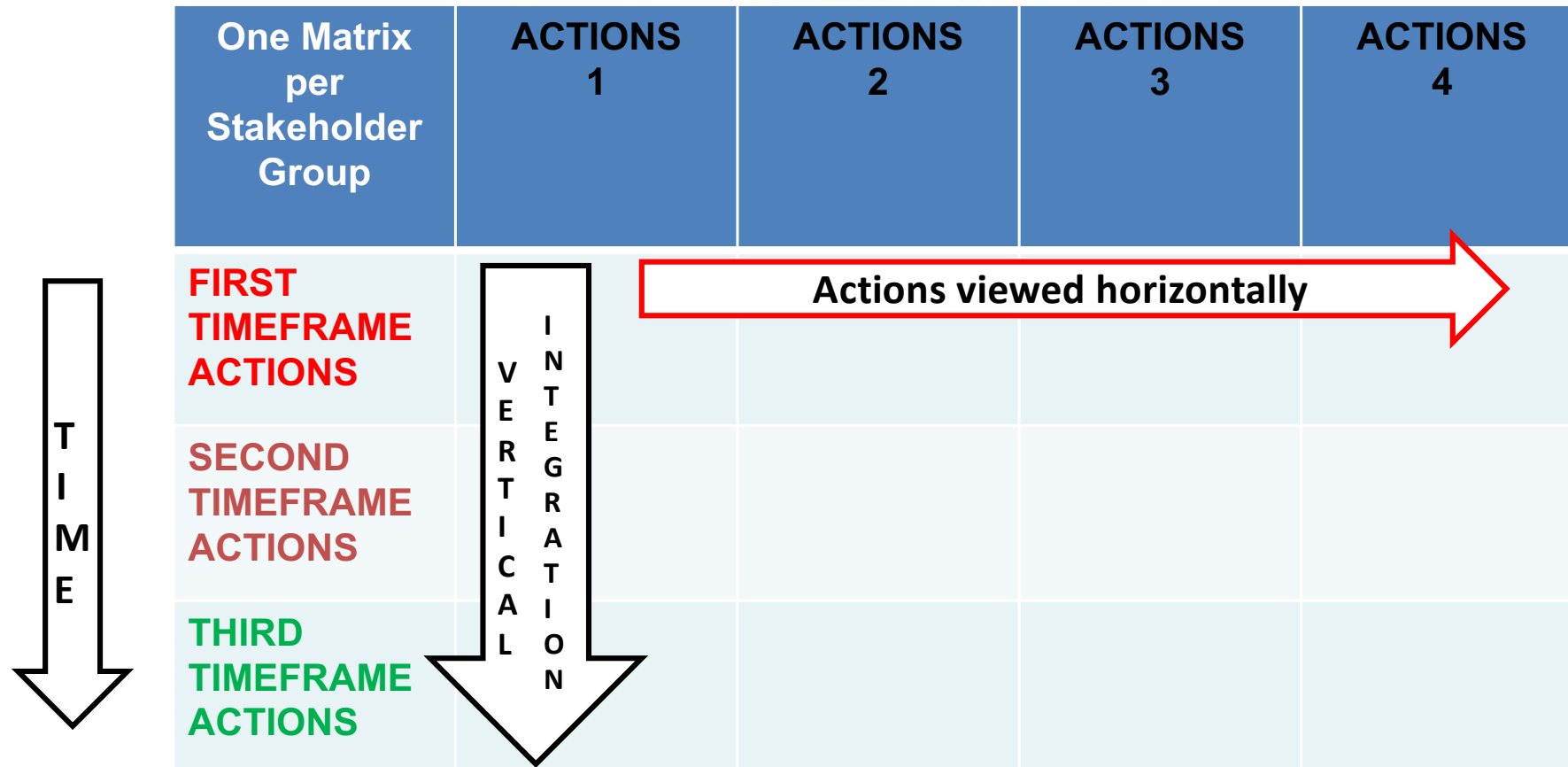


Overview of Complete Roadmap & Documents





WHAT CAN STAKEHOLDERS DO.... AND WHEN SHOULD THEY DO IT?



Each Stakeholder Group has four sets of 'Action Items' over three timeframes

Public sector	INTERAGENCY COORDINATION (VERTICAL & HORIZONTAL)	STANDARDS, REGULATIONS & TARIFFS (Poli-Techs)	INFORMATION , ANALYSES & COMMUNICATIONS	INCENTIVES, MANDATES & POLICIES
Gas Industry	DEVELOP GAS INDUSTRY NGV STRATEGY PLAN	DEVELOP CNG, LNG & BIOMETHANE FUEL STATION NETWORK	COMMUNICATIONS & OUTREACH TO NGV CUSTOMERS	ADVOCATE FOR GOVERNMENT SUPPORT FOR NGV MARKETS
OEMs, System & Component Suppliers	TECHNOLOGY DEVELOPMENT	STANDARDS AND REGULATIONS	MARKETING & COMMUNICATIONS	GOVERNMENT RELATIONS (ADVOCACY & EDUCATION)
Fleet Operators	VEHICLE OPERATIONS	FACILITIES MANAGEMENT (Fueling & Workshops)	INFORMATION & COMMUNICATIONS	PERSONNEL MANAGEMENT & TRAINING
Fuel Infrastructure Suppliers	TECHNOLOGY & SYSTEMS DEVELOPMENT (also best practices)	FILL GAPS IN STANDARDS & REGULATIONS	STRATEGIC MARKETING & COMMUNICATIONS	ADVOCACY & EDUCATING GOVERNMENT
Civil Society	TECHNOLOGY & SYSTEMS DEVELOPMENT (also best practices)	FILL GAPS IN STANDARDS & REGULATIONS	STRATEGIC MARKETING & COMMUNICATIONS	POLICY ADVOCACY , EDUCATING & TRAINING

TIMEFRAME FOR ROADMAP ACTIONS












- The Roadmap timeframes for action are in three sections, *arbitrarily but reasonably* set in a **total five-year block at:**
 - **Year 1:** Laying the Foundations
 - **Years 2 & 3:** Building & Implementation
 - **Years 4 & 5:** HDV Program Expansion
- Naturally, some of the actions may be accelerated and others may take longer.
- **Stakeholders, of course, may choose to re-arrange actions or change these timeframes to suit the given situation at any specific time.**
- All the Stakeholder Action Matrices are in the Annex to this Part 2.
- A Master Matrix of all the stakeholder Actions/Timeframes, combined in a separate Excel document, enables a user-friendly view of all stakeholder actions horizontally and in parallel (to see the linkages and cross-cutting activities) and vertically, to see the progression of activities over the timeframes.



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PART 2

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- **Process.** For government policy makers to set the stage, understanding the essentials of horizontally integrating policy making and vertically integrating stakeholder participation. All else follows from here.  
- **Standards & Regulations.** Addressing what is needed; identifying gaps and overcoming potential obstacles to further progress. 
- **Lower the Costs & Improve the Economics.** Actions to get the costs of NGV technology down to improve the Total Cost of Ownership (TCO) for fleet operators. 
- **Fuel Infrastructure.** Understanding the customers' fueling needs and strategies to facilitate user-friendly and affordable methane fueling. (*Introducing the chickens to the nests filled with CNG/LNG & biomethane eggs.*) 
- **Fleet Operations & Vehicle Availability.** Leadership and cooperation to make vehicles available and improve the TCO.  + 
- **Communications & Public Relations.** Commercialization through information and knowledge. 
- **A word about Timeframes & Milestones.** Policies and targets set should be *sensible* and *achievable* in the right timeframes! 

PART 2

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Annexes

- **Annex 1: STAKEHOLDER ACTIONS MATRICES**

The Action Matrices for the six stakeholder groups each have three sheets, representing the three proposed timeframes of activities.

All of these are combined in a separate Excel Master Matrix document in order to view all stakeholders in context to one-another.

- **Annex 2: EFFECTIVE DISSEMINATION OF THE ROADMAP TO SPEED IMPLEMENTATION**

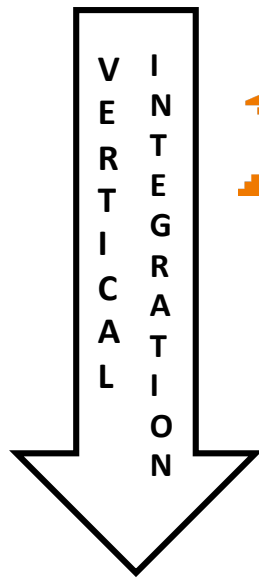
Ideas provided about how to disseminate the Roadmap results and documents.

- **Annex 3: NGV DOCUMENT RESOURCE LIBRARY FOR BRAZIL STAKEHOLDERS**
Background & Support to Roadmap (Listing of Topic Content)

PROCESS



Essentials of horizontally integrating policy-making and Vertically integrating Public-Private Partnerships (P³)



Best Strategies: Lessons Learned *Establishing 'Institutional Legitimacy'*



- ***Positive-sum (win-win) approach is best.*** When everyone has something to gain, everyone stays engaged!
- ***Stakeholder input*** is best for policy ***credibility, achievability & sustainability.***
- ***Reporting & feedback*** mechanisms allow for mid-stream corrections, improvements & sustainability.

- **A formalized data collection mechanism for *alternative fuel vehicles* and *fuel stations* is *essential* to determine successes in achieving milestones and understanding where improvement is needed.** (See U.S. Alternative Fuel Data Center - AFDC. <https://afdc.energy.gov/> as a potential model to emulate.)



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DOE's Alternative Fuels Data Center (AFDC) Tracks Each Alternative Fuel, providing an unbiased resource for public, fleets, & decision-makers



- Tracks Federal and State incentives.
- Clean Cities Network gathers alternative fuel prices quarterly and presented by the AFDC.
- Alternative Fueling Station Locator.
- AFDC Tracks vehicle classes by manufacturers.
- Provides interactive, user friendly maps & data.
- U.S. DoE offers Technical & Problem-Solving Assistance.
- AFDC is a source of **FLEET EVALUATION TOOLS** developed by DOE's National Laboratories.

Technical Response Service

- **First-level** resource for stakeholders, consumers, and others
- Research and response to general inquiries
- Help with challenging questions
- Education for legislators and government officials.

TechnicalResponse@icf.com, 800-254-6735

Tiger Teams

- **Second-level** resource for coordinators, stakeholders, and others
- Expert technical problem-solving to overcome obstacles
- Assistance on barriers that challenge local resources
- Help at any point in the project/product life cycle (concept, development, execution, operation/maintenance, closure)

Brazil might use (or modify) Argonne's AFLEET Tool to analyze *Costs & Benefits* of alternative fuels and vehicles



Examines light-duty & heavy-duty vehicle:

- Air pollutant emissions
- GHG emissions
- Petroleum use
- Cost of ownership

Contains 18 fuel/vehicle technologies, including:

- Conventional/Hybrids
- Plug-in electrics
- Natural Gas and Renewable Natural Gas
- Autogas
- Biofuels

Includes 7 Major Vehicle Types

Cost, MPG, & vehicle miles travel data on 26 vocations

Recently added off-road payback calculator to quantify the costs of off-road vehicles.

Updated annually



NREL's CNG VICE Model 2.0

Evaluate ROI and payback period for natural gas vehicles and infrastructure

INTERAGENCY COORDINATION (HORIZONTAL)

Public Sector Action Plan (Year 1)



Develop and manage Interagency policy making process horizontally at the Federal level.

- Create a ***HD NGV Commercialization Coordinating Committee***...or
- Other Federal-level interagency government groups already exist or are planned, as with *Fuel of the Future* technical committee (to be) composed of fifteen bodies and coordinated by MME. This could be *the* mechanism!(?)

Horizontal, Intra-government Coordination (A European perspective)



“Various Member States have taken the logical step to name an authority in charge of defining and implementing the *(Deployment of Alternative Fuels Infrastructure)* plan at national level. For example, in the Netherlands, a working group is set up with representatives of different ministries, holding frequent meetings and aligning efforts within their respective agencies.* ***It is essential to have clear alignment as different ministries may have conflicting objectives due to initiatives other ministries are not aware of.***”

*The **polder model** (Dutch: **poldermodel**) is consensus decision-making, based on the acclaimed **Dutch** version of consensus-based economic and social policy making in the 1980s and 1990s. ... The **polder model** has been described as "a pragmatic recognition of pluriformity" and "cooperation despite differences". (A *'polder'* is a piece of low-lying land reclaimed from the sea or a river and protected by dikes.)

Source: ***Clean Transport-Support to the Member States for the Implementation of the Directive on the Deployment of Alternative Fuels Infrastructure: Best Practice Example***, European Commission, 2016.

BNDES'S plan for market expansion of HD NGVs, already being developed, is aligned with many Roadmap recommendations*



- Expansion of the registration of brands and models of CNG vehicles.
- Financing of CNG stations in facilities of logistics and urban transport operators.
- Financing the qualification of CNG stations for the supply of heavy vehicles.
- Treatment of the regulatory issue *of diesel-gas*.
- Coordinated strategy for urban mobility.
- Structuring of blue corridors .

* Source: *Gas for the Development*, BNDES, February 2021

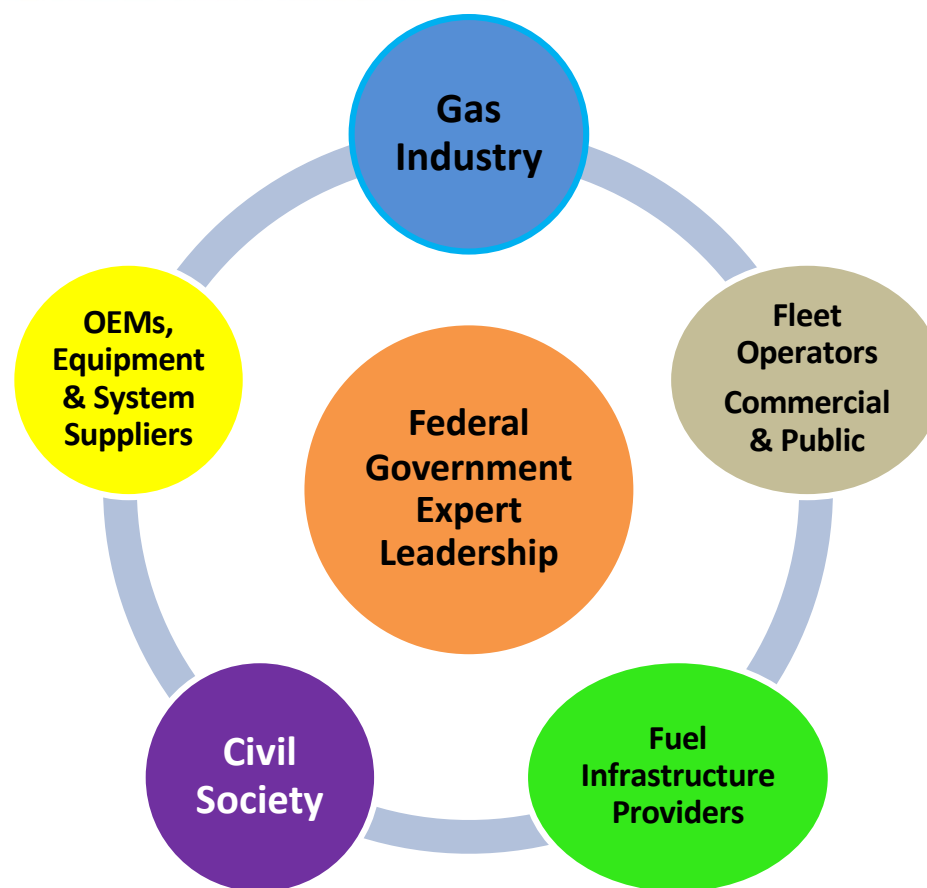
INTERAGENCY COORDINATION (VERTICAL)

Public Sector Action Plan (Year 1)



High Level Stakeholder Working Group on HD NGVs (Gas Buses & Trucks) for on-going policy input.*

Critical to getting on-going
policy input and (to the best
extent possible) consensus
*amongst stakeholder
representative groups.*



*Based on European Commission models: High Level Expert Groups; Stakeholder 'Platform' groups; Joint Undertakings (JUs), etc.

MEMBERSHIP & AGENDA FOR THE HIGH LEVEL HD-NGV STAKEHOLDER WORKING GROUP



*High Level Stakeholder Working Group membership is on-going & includes **NGOs, trade associations, & Civil Society** representing specific stakeholder groups to discuss:*

- Policy development (Incentives; taxation; etc.).
- Fuels and Infrastructure development strategies.
- Standards & Regulations development/refinement.
- Marketing strategies of vehicles and fleets.
- Education/Training.
- Communications & Outreach (including media and public relations).

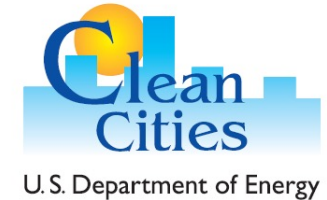
**CHAired & CO-CHAired BY HIGH-LEVEL, FEDERAL GOVERNMENT EXPERTS,
THE GROUP SHOULD MEET 4-6 TIMES A YEAR TO FOCUS ON SPECIFIC
OBJECTIVES, MILESTONES AND OVERCOMING CHALLENGES AND OBSTACLES.**

FEDERAL LEADERSHIP TO ENGAGE LOCAL/MUNICIPAL COOPERATION (VERTICAL INTEGRATION)



Public Sector Action Plan (Years 2 & 3)

Create framework for Brazil Clean Cities (BCC) program

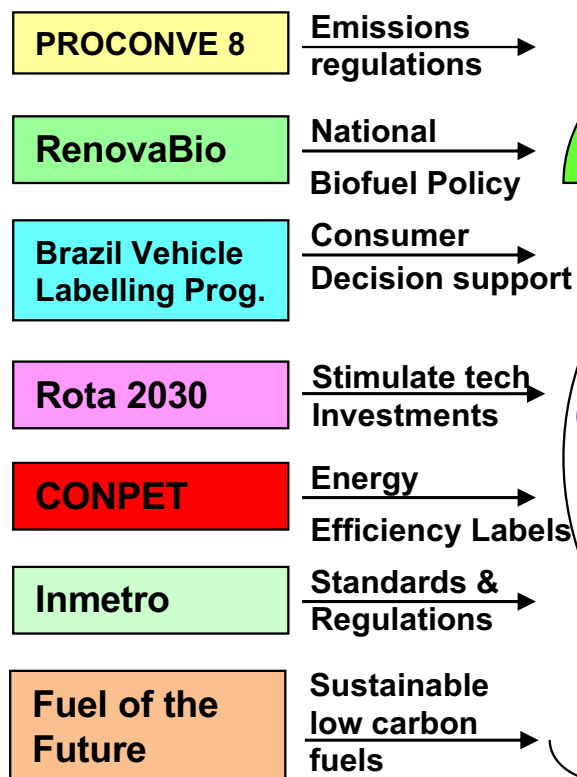


- **Under municipal leadership**, facilitate policies, budgeting, planning and decision-making with *local stakeholders* to build a clean transport system.
- Proven successful for nearly 3 decades, more than 75 cities, involving 18,000 stakeholders (39% private sector/61% public sector), representing ~80 of the U.S. population.
- **Identify a model city/test case (Sao Paulo, Rio?);**
- **In absence of a BCC (or in conjunction with), create NG Transit Users Working Group. (Share best practices; facilitate bus purchases; etc.)**

A Blue-Print for Brazil Vertical Implementation (Clean Cities)

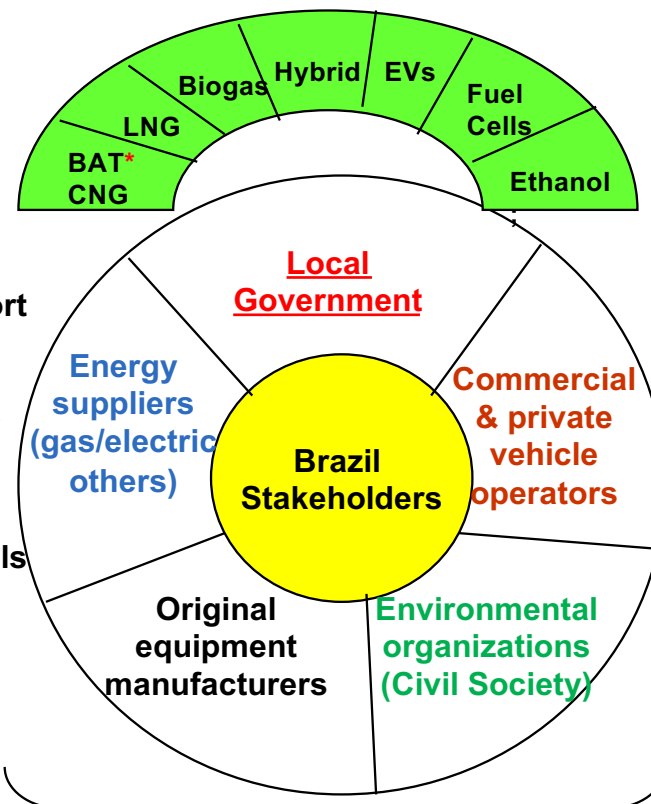
MULTI STAKEHOLDER INVOLVEMENT WITH ENVIRONMENTALLY FRIENDLY FUELS IN URBAN TRANSPORT

EXISTING BRAZIL PROGRAMS & TRANSPORT POLICIES

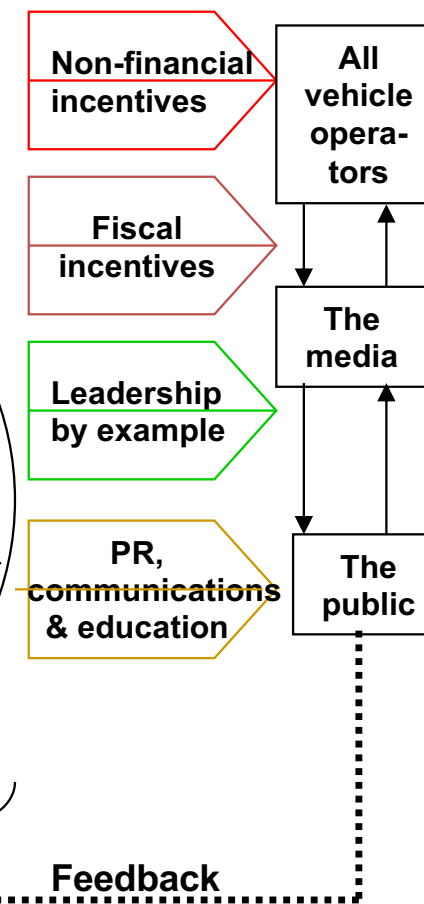


*Best Available Technology

NEW TECHNOLOGY INTRODUCTION



THE MARKET





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Six Steps to a Sustainable Alternative Fuel Transportation Market



- **Step 1:** Form a coalition and hold stakeholder meetings.
- **Step 2:** Appoint a coordinator.
- **Step 3:** Establish stakeholder commitments.
- **Step 4:** Develop a program plan or '*Roadmap*'.
- **Step 5:** Officially launch a coalition.
- **Step 6:** Implement the program plan.



CLEAN CITIES *COORDINATOR*: LEADERSHIP, SKILLS/ RESPONSIBILITIES ARE CRITICAL TO PROGRAM SUCCESS

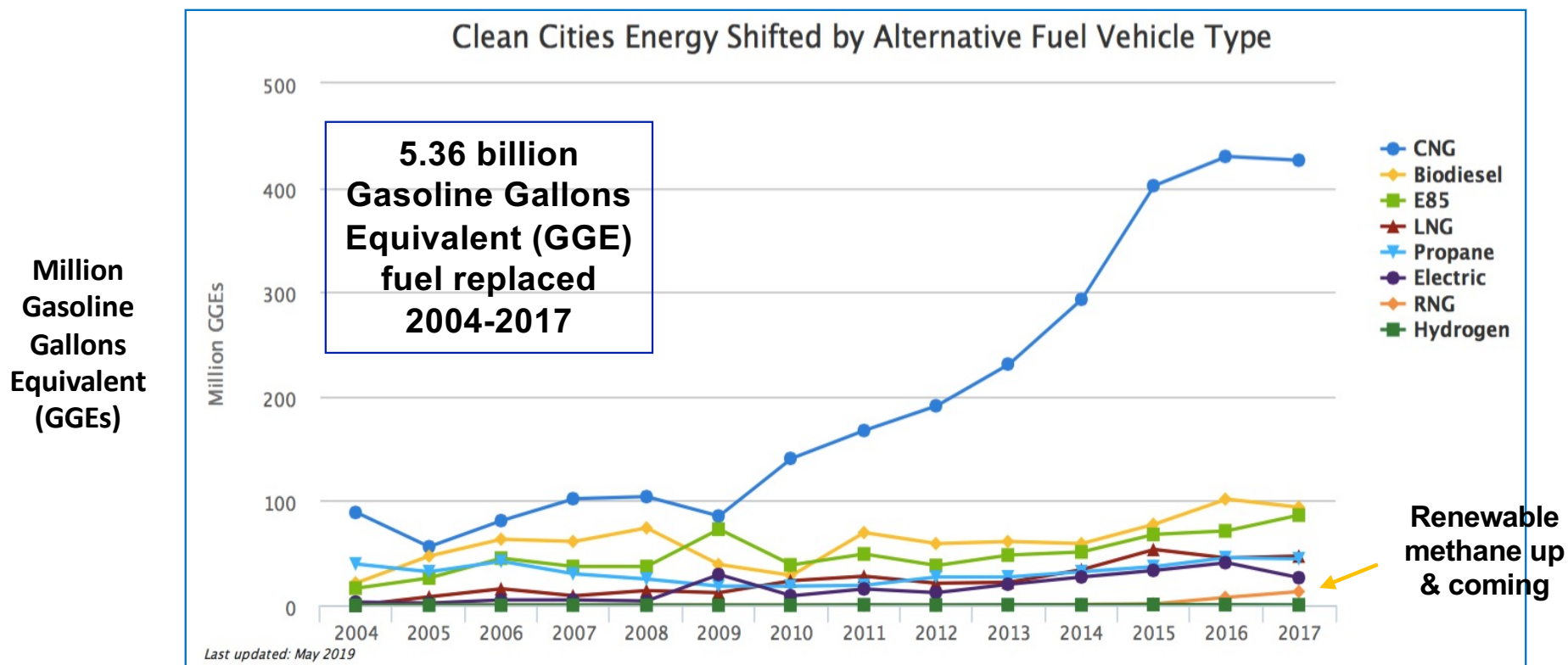
LEADERSHIP & SKILLS

- Engage stakeholders.
- Strategic planning and goal setting.
- Build consensus among coalition members.
- Present technical materials.
- Research grant opportunities.
- Develop project proposals.
- Project management.

RESPONSIBILITIES & ACTIVITIES

- Fleet outreach.
- Fleet vehicle emissions analysis.
- Fueling/charging infrastructure gap analysis.
- Collaborate with government agencies.
- Plan events/workshops/training.
- Utilize digital communication platforms.
- Connect stakeholders to technical assistance.

Annual Energy Impact of U.S. Clean Cities Alternative Fuel Usage 2004-2017



Alternative Fuels Data Center 2019, <https://afdc.energy.gov/data/>

CLEAN CITIES LESSONS LEARNED

Coalition projects have helped to put nearly
**1 million alternative fuel
vehicles** on the road.



**96 million gasoline
gallon equivalents**

of energy were saved through fuel economy improvement projects like telematics, driver training, and outfitting fleets with idle reduction equipment.



- Incentives
- Education and Outreach
- Niche markets are a must, including an anchor fleet
- Simultaneous development of infrastructure and AFVs
- Training, Training and More Training
- Program must be flexible to allow local solutions
- Bridging gap between available technologies and market demand requires technical, financial, and policy assistance
- Unbiased data on all available fuels and technologies
- Showcase achievements of fleet managers and recognize them
- Signage and visibility of cleaner technologies to inform public
- **Coordinators are the most important resource available to public and private decision-makers—Invest in Good Coordinators**
- **Coalitions comprised of the public and private sector will achieve success**

References and Resources

- AFDC Light-Duty Vehicle Search and Heavy-Duty Vehicle and Engine Search (<https://afdc.energy.gov/vehicles/search/>)
- AFDC Station Locator (<http://www.afdc.energy.gov/locator/stations/>)
- AFDC Vehicle Cost Calculator (<http://www.afdc.energy.gov/calc/>)
- AFDC Federal and State Laws and Incentives (<http://www.afdc.energy.gov/laws/>)
- AFDC Natural Gas Fueling Infrastructure Development
(http://www.afdc.energy.gov/fuels/natural_gas_infrastructure.html)
- AFDC interactive fueling animation (http://www.afdc.energy.gov/vehicles/cng_tank_animation.html)
- Clean Cities, *Costs Associated with CNG Vehicle Fueling Infrastructure*
(http://www.afdc.energy.gov/uploads/publication/cng_infrastructure_costs.pdf)
- NREL, VICE 2.0 (<http://www.afdc.energy.gov/uploads/publication/vice2-0.pdf>)
- Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool (<https://greet.es.anl.gov/afleet>)
- Clean Vehicle Education Foundation, *Guideline for Determining Modifications Required for Adding CNG and LNG Vehicles to Existing Maintenance Facilities*
(https://www.ngvamerica.org/wp-content/uploads/2018/03/NGVA_NGV-Facility-Guidelines_Rev-5-17-17.pdf)
- Natural Gas Vehicle Institute, *Facilities Modification for Natural Gas Vehicles*
(https://www.ngvi.com/wp-content/uploads/2018/06/FacilitiesModificationforNaturalGasVehiclesPaper_000.pdf)
- NFPA 52, Vehicular Gaseous Fuel Systems Code, and NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages (<http://www.nfpa.org/>)

LOCAL/MUNICIPAL COORDINATION (VERTICAL)

Public Sector Action Plan (Years 4 & 5)

Expanding the network of Brazilian Clean Cities will create long-term sustainability for environmentally friendly urban mobility....
and create lasting partnerships for future policy implementation!

STANDARDS & REGULATIONS



- Designed with safety & consumer protection in mind.
(‘Model’ standards ‘codified’ become Regulations)
- Regulations are implemented as ‘legal instruments’ and, therefore, are *enforceable!*
- **In the absence of standards/regulations, new technologies cannot enter the market.**

POTENTIAL OBSTACLE TO FUTURE PROGRESS

Public Sector Action Plan (Year 1 & on-going)



International models exist to help fill gaps in Brazil NGV regulations but they are *not yet* adopted by Inmetro

- ✓ **L-NGVs.** Begin development of standards/regulations for LNG trucks, fuel tanks, connectors/receptacles & stations (LNG & L-CNG).
 - **Models exist: ISO standards & UNECE regulation R.110**
- ✓ **Dual-fuel.** Begin development of regulations for Dual-Fuel (diesel-gas) conversion systems.
 - **Model exists: UNECE Regulation-49**
- **High-flow NGV-2 (HDV)** fuel connector for larger fuel volumes on truck & bus fueling should be **standardized** for faster filling of all HDVs.
 - **Models exists: ISO standards & UNECE regulation R.110**
- **Temporary exemptions** for HDV LNG truck and fueling should be considered while Brazil standards are developing.... ***if the technologies already are in compliance with international standards/regulations!***

Essential: adopt & use NGV-2 (ISO 14469-2) Universal quick-fill fuel connector for HDVs



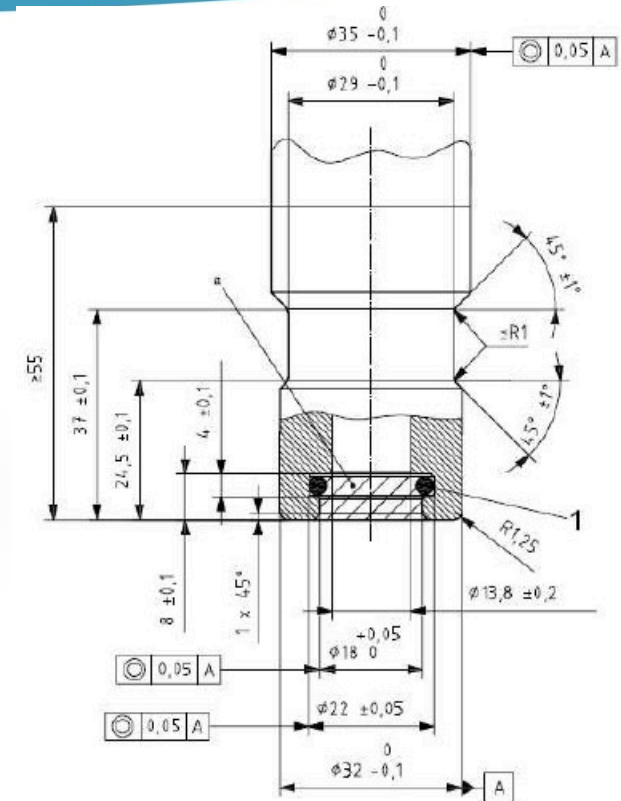
The currently used 'bayonet'-style fuel connector at Brazil public fuel stations is not adequate for high speed fueling requirements for HD trucks and buses.

NGV-2 provides for significantly reduced fueling time for HDVs. (Classes M2, M3, N2 & N3 vehicles)

NGV-1 (light duty vehicles) and NGV-2 are the universally accepted CNG connectors by the NGV industry worldwide.



Photo: WEH



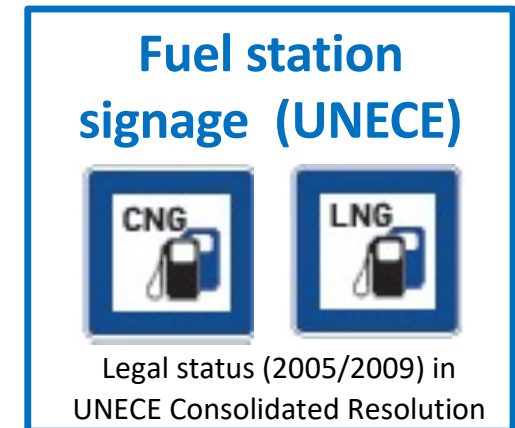
**NGV-2 is approved by
ISO & in UNECE R.110**

OTHER IMPORTANT STANDARDS/REGS ISSUES

MONITORING, AMENDING & INVOLVEMENT IS NECESSARY



- Natural gas, LNG & biomethane⁺ composition.
 - Key issues: Wobbe index; Methane number (anti-knock resistance); and ethane content (CNG/LNG).
- Emissions certification test fuels.
- Small-scale liquefaction systems.
- ADR (dangerous goods vehicles) certified to run on CNG/LNG (UNECE ADR regulations exist).
- Create diesel-liter-equivalent (DLE) for user-friendly sale of gas to fleet operators.
 - Challenging for existing LDV market (*but possible*)
 - Possible (and recommended) for the ‘new market’ of HDVs
- If not already in force, CNG cylinder end-of-useful-life handling procedures.



⁺ **Biomethane quality.** Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, Ranp 685 – 2017. **ANP Resolution No. 685 OF 06/29/2017** establishes the rules for the approval of quality control and the specification of biomethane from landfills and sewage treatment plants for vehicular use and residential, industrial and **commercial** installations to be sold throughout the national territory. 28

ALL THE STAKEHOLDERS SHOULD BE INVOLVED WITH STANDARDS AND REGULATIONS



- **Public Sector:** Leadership & expertise.
- **Gas Industry:** Already engaged but continual input needed.
- **OEMs equipment & component suppliers:** Engagement directly or through representative associations.
- **Fleet operators:** Advocacy to government and/or engagement through representative associations.
- **Fuel infrastructure suppliers:** Engagement directly or through representative associations.
- **Civil Society:** Add technical expertise (engineering & safety).

OPPORTUNITIES TO LOWER COSTS & IMPROVE THE ECONOMICS (TCO)



- Stabilization of fuel price differential between natural gas and diesel.
- Federal & local taxes: fuel, vehicles & road.
- Reduce import tariffs for NGV technologies.
- Financial incentives/assistance: subsidies & loans.
- Lowering regulatory costs.
- Carbon credits to OEMs and fleets.
- OEM favorable fleet leasing program vs. purchase.

All stakeholder engagement is needed, with the focus on
the ultimate customer: ***fleet operators!!***

Stabilization of fuel price differential between natural gas and diesel is THE key for fleet operators.



- Typically, 30-50% differential between natural gas and diesel is needed to achieve favorable economics and TCO.
- Since 2001 the fuel price differential has ranged between 21% and 35%. On average, natural gas has been 25% less than diesel.
- Developing a policy mechanism to stabilize the price differential is complicated by exchange rates (with the US\$), as well as institutional and regulatory challenges.
- **Conclusion:** A price-differential-stabilization-mechanism may be impossible to create, so: *Other* price reduction mechanisms must be developed to create a favorable TCO for fleet operators.

A 'Wish List' of possible cost-reductions Federal & local taxes: fuel, vehicles & road



- **Reduction of state natural gas fuel tax**, specially ICMS (a form of VAT), which varies by state, between 7% and 18%.
- **Reduction of tax for CNG/LNG trucks acquisition.**
- **Exemption for the annual ownership tax (IPVA)**, applicable to CNG/LNG trucks. It is a state tax and the criteria change by jurisdiction. Tax normally ranges from 1.5% to 4% of the asset assumed price. (Some states already give discounts for NGVs.)
- **Price reduction of annual mandatory insurance (DPVAT)**, applicable to CNG/LNG trucks. It is a fixed price, depending on the vehicle category.
- **Price reduction of annual licensing**, applicable to CNG/LNG trucks.
- **Exemption of road tolls**, applicable to CNG/LNG trucks. Prices vary, depending on the road concession contract and number of axles. *(Has been very popular and successful in Germany!)*

STATE TAXATION OF GASEOUS & LIQUID FUELS can be a cost-cutting opportunity or a challenge*



- Natural gas sales are taxed differently by each state. Most of the sales tax (ICMS) receipts go to the gas-producing states.
- Gas-producing states lower taxes on natural gas in order to incentivize consumption.
- Non-gas-producing states introduce prohibitive sales tax on natural gas, since the fuel will only reduce their tax receipts.
- Liquid fuels work differently. The state where the fuel was consumed receives all of the tax receipts. Therefore, many non-producing states prefer to continue incentivizing diesel.

*Based on private communication with EPE stakeholder.

Tariffs impede the importation of critical NGV technologies



Create favorable tariff conditions to make imported NGV technology that is *not available* in Brazil more cost-competitive as Environmentally Friendly Technologies (EFTs)

- CNG/LNG trucks and *lightweight* CNG cylinders (currently as much as 35% import tax).
- Gas engines, NG fuel systems and other equipment.
- Generally, expand the so-called “ex-tarifario” granted for ISO-certified CNG cylinders and LNG dispensers. For example, reduce import taxes from 35% to.... 3%(?).

Financial incentives/assistance: subsidies, loans, credits & deductions.



**BNDES has been developing a variety of innovative incentive concepts,
loans and financial assistance models**

- **Procaminhoneiro program and Finame** – Financing Fund for the Acquisition of Machinery and Equipment); support for truck maintenance (such as the BNDES Trucker Credit program).
- **Adapting the BK Acquisition** – Bus and trucks in order to provide financing of used vehicles powered by natural gas; also to build a secondary market for HDV NGVs.
- **Cooperation and promotion of pilot projects.**
- **Low Carbon Mobility Project.**
- **Blue Corridor planning and support.**
- **Financing program for purchase of new vehicles & conversion of used buses.**

Market-Based Incentives

Creative Financing to make it easy on the customer



- Egyptian 'shared savings plan' organized by government & Nassar Bank
- No cost 'loans' to taxi drivers to convert vehicles: conversions provided 'free' (conversion company paid *directly* by bank).
- Cost repaid by paying petrol price for natural gas until loan is repaid, then fuel costs drop by 50%.
- Cash flow back to bank/government is continual and can be 'recycled' back to new customers.
- Cleaner air contribution is immediate and growing.
- Revenue impact = time value of money loaned.

A BRAZILIAN ADAPTATION

- BNDES finances vehicle price difference (lease or sale) between diesel and gas variant *at a favorable interest rate*.
- Fleet operator pays for gas at the diesel price until loan is repaid.
- BNDES might set a minimum fixed price differential for gas-to-diesel to improve TCO.

Regulatory cost reduction for cylinder manufacturers: *Certificate of Conformity (CoC) for the **life** of the cylinder*



- CNG cylinders are manufactured to a certified life of 15-20 years. They are subject to *periodic inspections* along with auto safety inspections (**not** re-certification).
- **BUT:** Current Brazil regulations require foreign CNG cylinder manufacturers to undergo complete CoC **re-certification every three years** at a cost of R\$ 300,000 (US\$ 53,395).
- This requirement is not associated with safety and *seems to be* a punitive, revenue-raiser that will further drive up the cost of already-expensive imported lightweight CNG cylinders.



Additional potential cost reduction concepts to support OEMs & fleet purchases of NGVs.



- **Carbon credits to OEMs and fleets.**

Provide carbon credits to OEMs for building/selling NGVs and to fleet operators for purchasing them. Can be tied to Proconve 8 (for OEMs) and tons/GHGs reduced by fleets.

- **OEM favorable fleet leasing program vs. purchase.**

Helps reduce the cost burdens – initially – of modifying maintenance facilities to accommodate gas vehicles & and doing self-maintenance (training required).

- **For municipalities, in particular, create collaborative vehicle purchase programs to reduce higher cost of vehicles.**

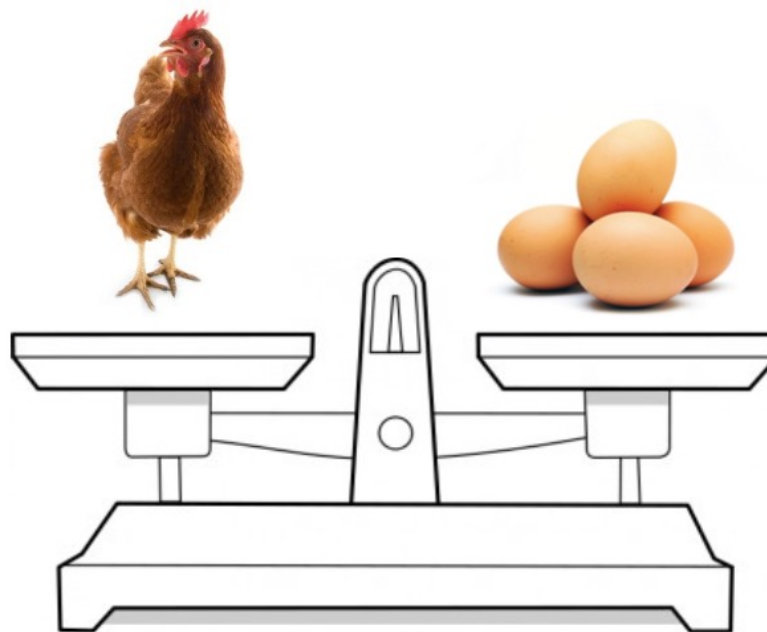
Working with other fleet operators and OEMs, developing ‘*bulk purchases*’ of similar vehicles (buses) vs. smaller, individual vehicle purchases could result in reduced costs (economy of scale) to both OEMs and fleet operators.



Balancing Chickens & Eggs



There are a wide variety of options and opportunities to develop the fuel station network to suit the short-medium-and- long-term needs of fleet owners & operators.



Municipal Fleets

- Buses
- Garbage Trucks

Logistics Fleet Operators

- Larger Commercial
- Smaller Private

Understanding the fueling preferences for HDV fleet operators is critical to creating the appropriate and sustainable HDV fuel network



Locating Fuel Stations

- **Public stations** must be evaluated to determine storage & compressor capacity suited for high-flow HDVs to avoid back-ups of LDV customers. (And ready to provide NGV-2 fuel connector.)
- **Central, on-site fuel stations** are most popular for many fleet operators (fuel price discounts for large volumes; technical control over fueling operations).
- **Dedicated HDV stations *shared* by multiple fleets** strategically located, inside the urban core. Economic for fleets & attractive for gas retailers for high-volume gas sales (including biomethane).
- **Blue Corridors/gas highways** for over-the-road trucking: Shared public stations or at designated truck-stops.

Gas Delivery Options

- **Pipeline gas** directly to the compressor station.
- **Mother-daughter stations:** fuel brought by large-volume trucks from a central fuel depot to local stations, either CNG, LNG or biomethane....as a '*virtual pipeline*.'
- **Truck-mounted portable fueling stations** (CNG and LNG) appropriate for small private fleets or fleet demonstrations 'trying out' a small numbers of trucks.

Fuel station ownership options will largely determine the cost and economics for the fleet operator



PUBLIC FUEL STATIONS & SHARED-HDV STATIONS FOR MULTIPLE FLEETS (urban centers)

- Vertically integrated gas production & distribution company, from extraction to the pump.
- Gas wholesaling companies reselling NG/LNG/biomethane.

PRIVATE, CENTRAL FUEL STATION ON-SITE AT FLEET OPERATOR'S FACILITY

- Fleet operator owns & operates fuel station (\$\$!).
- Third party service provider sells its own gas (bio) or re-sells gas on a *turn-key*, full-service basis.

GAS SELLERS OPTION TO STABILIZE FUEL PRICE DIFFERENTIAL



- Natural gas seller provides price of gas linked to the price of diesel at X% (30-50%?), guaranteeing a stable price difference.
- Based on a long-term contract (5 years?).
- Technique helps fleet operators determine favorable TCO based on price stability compared to diesel.

EXAMPLE OF A MULTI-STAKEHOLDER PARTNERSHIP FOCUSED ON THE CUSTOMER



Clean Energy..
Cummins, OEMs &
Fuel System
Providers
Zero Now Offering

1



Customer purchases or leases natural gas tractor at *'diesel price'*

2



Customer signs 5-year fuel agreement with Clean Energy; *FIXED below diesel (up to \$1)*

3



Up to \$40K of incremental cost of natural gas truck is covered by Clean Energy/TOTAL based on ② 'take or pay' gas contract

4



Customer fuels at Clean Energy (RNG) stations

90% reduction in W2W GHG



Roadmap do Mercado Brasileiro de VEÍCULOS PESADOS A GNV

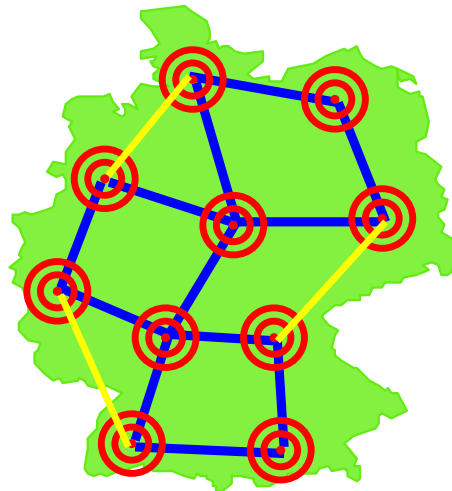
Infrastructure Concepts & Strategies for HDVs (Cores, Rings & Corridors)



BNDES Blue Corridor Plan: Phase 1



BNDES has done excellent analyses to prepare for expansion of the NGV fuel station network.



BNDES Blue Corridor Plan: Phase 2



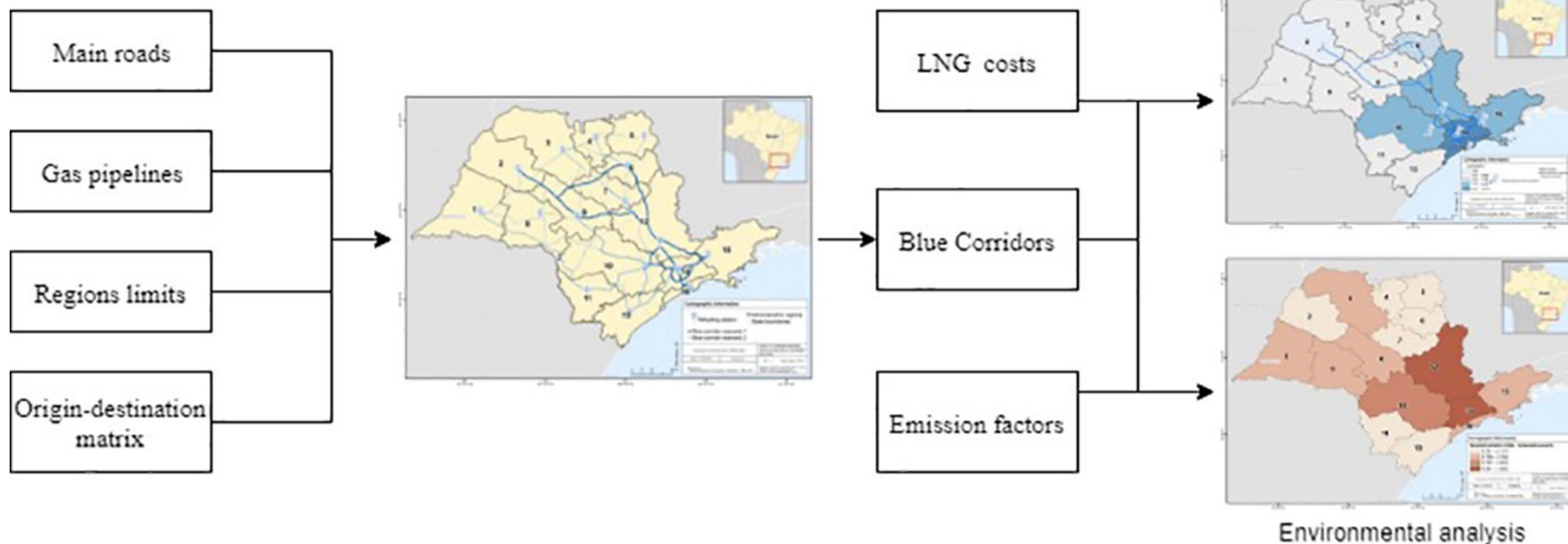
German core-rings-&-corridor strategy

(Supported by surveys: How far people will travel to get gas.)



Emissions reductions over diesel can be significant along the LNG Blue Corridor

-5.2% GHGs -80% PM -75% NOx



Source: *Costs and emissions assessment of a Blue Corridor in a Brazilian reality: The use of liquefied natural gas in the transport sector*, Dominique Mouette, Science of the Total Environment 668 (2019) 1104–1116.



Opportunity: Focus on “hub ports” (air & sea)



- Airports and seaports are important, high fuel-consuming ‘hub’ locations serving many diverse and high-fuel-consuming vehicle operators (trucks, ships & rail).
- Typically, airports & seaports are sources of highly concentrated air pollution.
- Large number of vehicles visit and circulate continuously.
- Many types of fleets: public & private sectors (LDV & HDV).
- Need very few fueling stations within the facility (one in the ‘secure areas’ and one for public access).
- Highly visible for visitors and other fleets operators.
- New opportunities at LNG receiving terminals to deliver to LNG trucks or CNG as L-CNG.

(ISO has developed fuel connector & bunkering standards for LNG ships.)



EU. Maglog project

High Level Stakeholder Working Group on HD NGVs is the platform for stakeholders to shape the future of the NGV fuel station network.



(From the Action Matrices)

Gas industry

First Timeframe Actions:

- 1) Develop coordinated marketing plan with fuel station suppliers and vehicle manufacturers targeting fleets & municipalities;
- 2) Combine effort with OEMs & vehicle converters' needs and targets.

Second Timeframe Actions:

Help develop (w/public sector) Blue Corridor plan to integrate biomethane and LNG into the network and to directly target NGV customers.

Third Timeframe Actions:

Create '*NGV Port Plan*' for airport and seaport fuel and truck integration.

High Level Stakeholder Working Group on HD NGVs is the platform for stakeholders to shape the future of the NGV fuel station network.
(From the Action Matrices)



Fuel Infrastructure Suppliers

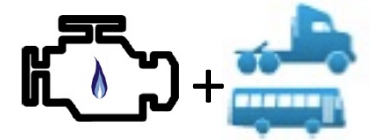
First Timeframe Actions:

- 1) Understand (identify) gas network expansion near fleets.
- 2) Identify best fueling options for fleets: (portable; M-daughter & stationary).
- 3) Identify large fleets for shared anchor station sites.
- 4) Identify potential NGV Champion pilot fleets.

Second Timeframe Actions:

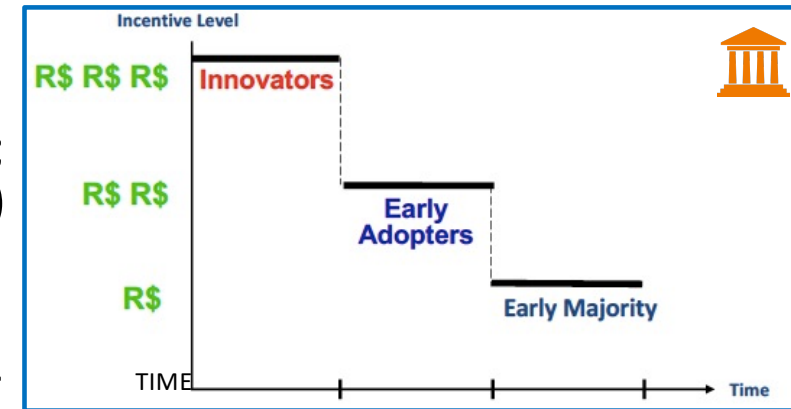
- 1) Coordinate station roll-outs with gas & vehicle providers.
- 2) Develop L-CNG station options (if LNG is available).
- 3) Create NGV 'Port' plan for airport and seaport fuel and truck integration.

LEADERSHIP & VEHICLE AVAILABILITY IN IMPROVING THE TCO



Fleet Operators **First Timeframe Actions**

- 1) Evaluate CNG & LNG vehicle availability and fuel options.
(For LNG, as standards/regulations may allow)
- 2) Understand associated facility modifications (maintenance; on-or-off-site fuel station(?); potential training requirements.)
- 3) Consider being an **early-adopter NGV Champion**, at least as a trial program. (Leadership by example benefits!)
- 4) Advocate/communicate with Public Sector (at all levels) for funding and incentives; also Analytic TCO tools from government(and OEMs?). (*reference U.S. AFLEET tool*)

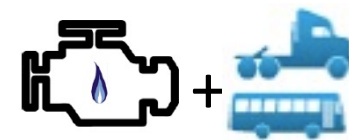


Encourage public sector funding of innovative NGV Champions

Fleet Operators **Second Timeframe Actions**

Develop fleet implementation plan including route-planning; fuel options on-and-off fleet premises; securing financial incentives from public sector; and training (drivers & mechanics – unless OEM-provided via lease option).

OEMs, SYSTEM SUPPLIERS & FLEETS WORK TOGETHER TO ESTABLISH FLEET VEHICLE PREFERENCES, POTENTIAL AVAILABILITY & ATTRACTIVE TCO OPTIONS



OEM/Vehicle System Suppliers

First Timeframe Actions

- 1) Profile main large fleet operators to identify truck & bus needs w/AFV potential.
- 2) Create HD NGV marketing strategy.
- 3) Identify potential NGV Champion pilot fleets.
- 4) Ramp up NGV production capacity with vehicles fulfilling fleet performance and TCO requirements.
- 5) Participate in development of full suite of LNG standard (trucks, tanks, fuel connectors, etc.).

Second Timeframe Actions

- 1) Work with suppliers to import & certify lightweight CNG cylinders Types III & IV.
- 2) Customer outreach with NGV products.

COMMUNICATIONS & PUBLIC RELATIONS

All Stakeholders have responsibility for “NGV Outreach”

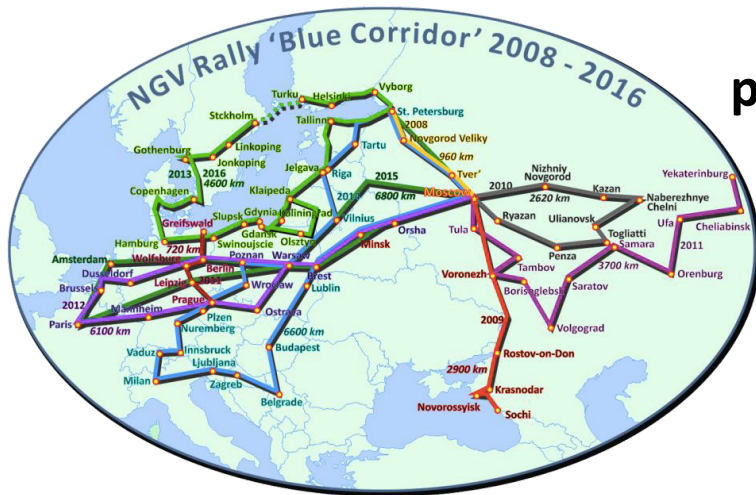


- **Public Sector.** Outreach & analyses to provide confidence to stakeholders of a firm policy direction and goals.
- **Gas Industry.** Targeted media campaign to truck & bus fleets touting economics & environmental benefits of NGVs.
- **OEMs & Equipment Suppliers.** Targeted outreach to largest fleet operators (commercial & municipal) to provide NGVs matching customer profile.
- **Fleet Operators.** Tell customers their ‘green fleets’ are environmentally responsible. Also, to share operational and best practice experiences with stakeholders and policymakers;
- **Fuel Infrastructure Providers.** Identify and target large fleets for best fuel options and identify opportunities for shared, HDV fuel station and anchor fleets.
- **Civil Society.** Identify potential *early adopters* and “*Champion pilot fleets*”; Provide results of analytics to government and other stakeholders.



Roadmap do Mercado Brasileiro de VEICULOS PESADOS A GNV

Public relations and advertising campaigns touting Environmentally Friendly, Abundant Gas in Mobility for Today & Tomorrow. *Bringing the vehicles to the public!*



NGV Rallies have been a popular public relations opportunity; also to bring stakeholders together.



Twice across America: 1984 & 1986



Lisbon to Tokyo
15,000 km: from 5th Oct to 9th Nov 2009



NGV Rally-2018: 'GAS INTO ENGINES'
Russian & German Participants



URAL NEXT, LNG/CNG, 1000 km	KAMAZ 43118, LNG/CNG, 1300 km	Камаз NEO, LNG+Disel, 1600 km	Hyundai 87, LNG/CNG, 850 km	Lotos 105, LNG, 600 km	Уаз Патриот, CNG/petrol, 920 km	Лада Веста, LNG/petrol, 1050 km	VW Passat, CNG/petrol, 1000 km

MetanoGraph

THE CHALLENGE (and dilemma) OF CREATING TIMEFRAMES & MILESTONES



What to do and how long will it take?

- **Policies compressed in *too short* a timeframe** run the risk of not achieving their targets/goals; also, policy makers appearing unrealistic or overly aggressive in achieving their milestones.
- **Policies over *too long* a time run the risk of not being implemented** because stakeholders don't take the policy actions seriously or because they want to stall in accomplishing them.
- Accordingly, **milestones must be '*realistic*' and '*reasonably achievable*' in the planned timeframe!** Avoid making overly optimistic projections of vehicle and fuel station adoption, raising false expectations for stakeholders [**and investors(!)**]

A 'SOFT MANDATE' CONCEPT TO TRANSITION to NATURAL GAS HDVs WITH *REASONABLE MILESTONES*



Target Fleets of 10+ vehicles

- Concept based upon target population of fleets of 10+ HDVs.
- Natural turnover of HDV fleet vehicles based on 5 years in fleet before sold to second-hand market = 20% turnover of total fleet every year.
- 'Soft mandate' (*WITH incentives*) is to increase NGV % of NEW vehicle purchases of that 20% : Year 1= 10% NGVs; year 2= 20%; year 3= 30%; year 4= 40%; year 5=50% (and some % thereafter).
- For a fleet of 100 vehicles, 20 new vehicles bought per year, 10% = 2 vehicles. Should not be a hardship for any large fleet, even as the numbers grow annually.
- A lower percentage of annual vehicles purchases would make the target of NGV adoption slower but still result in *substantial* amounts of new HD NGVs.
- Instead of 'mandate' also could be a *target milestone*.
- **CAVEAT 1: The program depends upon vehicle availability of the types used by the large fleets.**
- **CAVEAT 2: Concurrent growth of fuel stations also is assumed!**

Milestones based on a graduated scale-up of NGVs in large fleets will drive the OEM production, fuel station development and large-scale sale of gas. Smaller fleets will follow!



Assumptions (example)

- **25% of total fleet vehicles are in fleets of 10+ = 474,568 vehicles.**
- 20% turnover p/year = 94,914 vehicles

% NGVs p/year Added	HD NGVs
10%	9,491
20%	18,982
30%	28,474
40%	37,965
50%	47,456
TOTAL in 5 yrs	142,368
OR: assume 10% p/yr for 5 years	47,455

Type of conveyor	Issued records	Vehicles/transporters
Transport companies (ETC)	154.234	1.172.250
Autonomous transporters (TAC)	533.913	700.911
Cooperative	343	25.112
Total	688.490	1.898.273

Source: BNDES elaboration, based on the National Register of Road Cargo Carriers (RNTRC), available by the National Land Transport Agency (ANTT), in http://www.antt.gov.br/cargas/arquivos_old/Statistics.html. Access in: 4 Jun. 2019. as in BNDES, GNV 2020



Roadmap do Mercado Brasileiro de
VEICULOS PESADOS A GNV

AND FINALLY, SOME NGV 'RULES OF THE ROAD'

1. LEAD WITH THE ENVIRONMENT

- Cleaner air at Proconve 8.
- Biomethane is a waste management *and* a transport strategy to achieve GHG goals on a W2W basis.

2. CARROTS AND STICKS, BUT NOT TOO MUCH STICK

- Attract Early Adopters, initially with highest incentives.
- Reduce subsidies gradually in accordance with growing market share.

3. ALL STAKEHOLDERS MUST BE COMMITTED TO USING NGVS THEMSELVES

- *Government*: Leadership by example.
- *Equipment sellers*: You sell NGVs? Drive NGVs!!
- *Gas industry*: Don't run your vehicles on the competitor's fuel (petroleum);
- *Infrastructure, Equipment suppliers & vendors*: Arrive at customer's site *driving* an NGV.

4. MAP OUT THE FUEL INFRASTRUCTURE WITH HUBS, SPOKES & CORRIDORS.

5. COMPETITION RESULTS IN LOWER PRICES (with the focus on fleet TCO) .

The Second-Hand market will develop 'organically', especially as the fueling network expands!



YOU HAVE THE ROADMAP. NOW, GET ON THE ROAD IN NGV TRUCKS AND BUSES!!





Roadmap do Mercado Brasileiro de
VEÍCULOS PESADOS A GNV






ANNEXES

ANNEX 1: STAKEHOLDER ACTIONS

ANNEX 2: EFFECTIVE DISSEMINATION OF THE ROADMAP TO SPEED
IMPLEMENTATION

ANNEX 3: NGV DOCUMENT RESOURCE LIBRARY FOR BRAZIL
STAKEHOLDERS (Table of Contents)

ANNEX 1 STAKEHOLDER ACTIONS

- *Government/Public Sector* 
- *The downstream natural gas industry* 
- *Vehicle manufacturers and NGV systems and component suppliers* 
- *Fleet operators* 
- *Fuel station and infrastructure suppliers* 
- *Civil society* 

STAKEHOLDER ACTION PLAN THE PUBLIC SECTOR



PUBLIC SECTOR ACTIONS

YEAR 1: Laying the Foundations



ACTIONS	INTERAGENCY COORDINATION (VERTICAL & HORIZONTAL)	STANDARDS, REGULATIONS & TARIFFS (Poli-Techs)	INFORMATION , ANALYSES & COMMUNICATIONS	INCENTIVES, MANDATES & POLICIES
<p>FIRST TIMEFRAME ACTIONS Year 1</p>	<p>1) Develop and manage Federal-level Interagency policy making process (Horizontal coordination); 2) Create High Level Stakeholder Working Group on Gas Buses & Trucks (HD NGVs) for on-going policy input (Vertical coordination); 3) Evaluate Federal Fleet options to use NG variants.</p>	<p>1) Begin development of standards & regs for LNG trucks, fuel tanks, connectors, receptacles & stations; 2) Begin development of regulations for Dual-Fuel conversions.; 3) Consider temporary exemptions (based on international stds/regs for HDV LNG trucks while Brazil standards develop; 4) Require use of NGV-2 (HDV) fuel connector in public and private fuel stations.</p>	<p>1) Identify and develop analytic tools for TCO & impact analyses (emissions, etc.) for policy development (and fleets); 2) Create framework & institute data collection on AFVs; 3) Study potential adaptations of select public stations for HDVs & potential for 'shared', dedicated HDV stations near fleets in/near urban centers; 4) Identify & support NGV Champion pilot fleets.</p>	<p>1) Consider (BNDES) 'Shared Savings Loan' model for fleet operators and all other financial (tax) incentives; 2) Include bio-methane in incentive policies; 3) Develop HDV Fleet-Friendly Fuel Station models & policy; 4) Offer carbon credits to OEMs providing HD NGVs and fleets purchasing vehicles.</p>

PUBLIC SECTOR ACTIONS

YEARS 2 & 3: Building & Implementation



ACTIONS	INTERAGENCY COORDINATION (VERTICAL & HORIZONTAL)	STANDARDS, REGULATIONS & TARIFFS (Poli-Techs)	INFORMATION , ANALYSES & COMMUNICATIONS	INCENTIVES, MANDATES & POLICIES
<p>SECOND TIMEFRAME ACTIONS Years 2 & 3</p>	<p>1) Create framework for Brazil Clean Cities (BCC) program; 2) Award model/test city case(s)- (Sao Paulo, Rio?); 3) In absence of a BCC, create NG Transit Users Working Group (best practices; possible joint purchasing programs, etc.).</p>	<p>1) Simplify on-going certification pathway for CNG Tanks (3&4) & LNG tanks (and trucks); 2) Create favorable tariff conditions to make imported NGV technology that is not available in Brazil more cost-competitive as Environmentally Friendly Technologies (EFTs).</p>	<p>1) Outreach analyses to states & cities (see BCC); 2) Identify gaps and needs for NGV information to public & stakeholders; 3) Develop & disseminate 'best practices' for vehicles & stations.</p>	<p>1) Focus on 10+ Bus & Truck Fleet purchase incentive plan (w/ High Level Stakeholder Working Group); 2) Formalize Blue Corridor plans & targets for fuel station growth; 3) Create NGV 'Port' plan for airport and seaport fuel and truck integration. 4) Evaluate impact of 'local content' policies on HD NGVs.</p>

PUBLIC SECTOR ACTIONS

YEARS 4 & 5: HDV Program Expansion



ACTIONS	INTERAGENCY COORDINATION (VERTICAL & HORIZONTAL)	STANDARDS, REGULATIONS & TARIFFS (Poli-Techs)	INFORMATION , ANALYSES & COMMUNICATIONS	INCENTIVES, MANDATES & POLICIES
<p>THIRD TIMEFRAME ACTIONS Years 4 & 5</p>	<p>1) Expand BCC program to establish network of Brazilian Clean Cities; 2) Facilitate communication between coordinators; 3) Initiate (as may be possible) AFVs/NGVs in Federal fleets.</p>	<p>1) Maintain on-going process for standards development & regulatory enforcement w/focus on safety & best practices; 2) Standardize energy units to sell alternative fuels (at least for fleet customers and stations); 3) Focusing on lightweight CNG cylinders, create and implement training program for technicians and periodic inspectors (who do routine vehicle safety inspections).</p>	<p>1) Support Blue Corridor Clean Bus & Truck Rally (promotion event) with all stakeholders; 2) Establish website of publicly accessible data for fleets including fuel station locator; 3) Continue to communicate successes and lessons learned.</p>	<p>1) Fund fleet demonstrations & case studies; 2) Obtain feedback from stakeholders & market to refine & expand incentives; 3) Setup central purchase program at national, regional or local level to support the public transport companies in tender preparation and potential cost-reduction through economy-of-scale vehicle purchases.</p>

STAKEHOLDER ACTION PLAN

The Downstream Gas Industry



The Downstream Gas Industry

YEAR 1: Laying the Foundations



ACTIONS	DEVELOP GAS INDUSTRY NGV STRATEGY PLAN	DEVELOP CNG, LNG & BIOMETHANE FUEL STATION NETWORK	COMMUNICATIONS & OUTREACH TO NGV CUSTOMERS	ADVOCATE FOR GOVERNMENT SUPPORT FOR NGV MARKETS
<p>FIRST TIMEFRAME ACTIONS Year 1</p>	<p>1) Create short, medium & long-term pipeline network expansion strategy linked specifically to new NGV markets; 2) Create companion plan (including fuel station options/models) targeting HDV truck & bus fleets, related to existing and planned gas availability; 3) Develop gas pricing strategy to maintain favorable cost differential with diesel.</p>	<p>1) Develop coordinated, strategic marketing plan with fuel station suppliers and vehicle manufacturers targeting fleets & municipalities; 2) Combine effort with OEMs & vehicle converters to identify target fleets, opportunities and their needs (especially Total Cost of Operation-TCO).</p>	<p>Create broad information and advertising campaign touting Environmentally Friendly, Abundant Gas in Mobility for Today & Tomorrow.</p>	<p>1) Identify and advocate to remove regulatory barriers & gaps, especially related to: NGV-2 connectors; CNG cylinders; LNG components/fueling; dual-fuel systems; and biomethane distribution; 2) Maintain on-going presence in standards & regulatory process.</p>

The Downstream Gas Industry

YEARS 2 & 3: Building & Implementation



ACTIONS	DEVELOP GAS INDUSTRY NGV STRATEGY PLAN	DEVELOP CNG, LNG & BIOMETHANE FUEL STATION NETWORK	COMMUNICATIONS & OUTREACH TO NGV CUSTOMERS	ADVOCATE FOR GOVERNMENT SUPPORT FOR NGV MARKETS
<p>SECOND TIMEFRAME ACTIONS Years 2 & 3</p>	<p>Help develop (w/public sector) Blue Corridor plan to integrate biomethane and LNG into the network & to directly target NGV customers.</p>	<p>1) Help develop (w/public sector) Blue Corridor plan to integrate biomethane and LNG into the network & to directly target NGV customers; 2) Create NGV 'Port' plan for airport and seaport fuel and truck integration.</p>	<p>Develop and implement targeted media campaign specifically for truck & bus fleets touting economics & environmental benefits of NGVs.</p>	<p>1) Advocate for subsidies/credits for biomethane injection & distribution; 2) Advocate favorable tariff conditions to make imported NGV technology (components & systems) that are not available in Brazil more cost-competitive as Environmentally Friendly Technologies (EFTs).</p>

The Downstream Gas Industry

YEARS 4 & 5: HDV Program Expansion



ACTIONS	DEVELOP GAS INDUSTRY NGV STRATEGY PLAN	DEVELOP CNG, LNG & BIOMETHANE FUEL STATION NETWORK	COMMUNICATIONS & OUTREACH TO NGV CUSTOMERS	ADVOCATE FOR GOVERNMENT SUPPORT FOR NGV MARKETS
<p>THIRD TIMEFRAME ACTIONS Years 4 & 5</p>	<p>1) Evaluate milestones and achievements to adapt network expansion strategy as needed; 2) Continue incorporating NGV planning into larger gas industry transition to more competitive gas markets (including LNG and biomethane).</p>	<p>1) Survey and assess fleet operators and station installers views & needs related to their fuel stations; 2) Expand efforts to integrate biomethane into overall natural gas expansion plan for vehicle fueling; 3) Expand efforts to integrate LNG into overall natural gas expansion plan for HD vehicle fueling.</p>	<p>Communicate and cooperate with gas industry principals and NGV stakeholders to support (financially and logistically with fueling) national Blue Corridor Rallies to reach city bus and private truck fleets operators.</p>	<p>1) Advocate national, balanced alternative fuels strategy & fuel corridor plan; 2) Continue to advocate well-to-wheel considerations of alternative fuels and assessing milestones on tons of pollutants reduced due to NGVs.</p>

STAKEHOLDER ACTION PLAN

Vehicle Manufacturers and NGV System/Equipment Suppliers



Vehicle Manufacturers and NGV System/Equipment Suppliers

YEAR 1: Laying the Foundations



ACTIONS	TECHNOLOGY DEVELOPMENT	STANDARDS AND REGULATIONS	MARKETING & COMMUNICATIONS	GOVERNMENT RELATIONS (ADVOCACY & EDUCATION)
<p>FIRST TIMEFRAME ACTIONS Year 1</p>	<p>1) Plan for and expand NG bus & truck product offerings to fit customer profiles; 2) Ramp up NGV production capacity with vehicles fulfilling fleet performance and TCO requirements.</p>	<p>1) Help develop LNG tank, fuel connector & receptacle standards; 2) Advocate NGV-2 fuel connector & receptacle only for HDVs; 3) Dual-fuel suppliers, in particular, work to create favorable regulatory framework for D-F systems.</p>	<p>1) Profile main large fleet operators to identify truck & bus needs w/AFV potential; 2) Create HD NGV marketing strategy; 3) Identify potential NGV Champion pilot fleets.</p>	<p>1) Advocate creation of a national fleet customer data base to determine vehicle requirements (also to match gas pipeline supply to municipalities); 2) Advocate for NGV incentives to help defray the higher cost of NGVs over diesel.</p>

The Downstream Gas Industry

YEARS 2 & 3: Building & Implementation



ACTIONS	TECHNOLOGY DEVELOPMENT	STANDARDS AND REGULATIONS	MARKETING & COMMUNICATIONS	GOVERNMENT RELATIONS (ADVOCACY & EDUCATION)
<p>SECOND TIMEFRAME ACTIONS Years 2 & 3</p>	<p>Develop Euro VI natural gas options for 2022/3 and beyond.</p>	<p>1) OEM and cylinder providers work to certify CNG cylinders Types III & IV; 2) Monitor & advocate natural gas (CNG, LNG and biomethane) fuel quality standards best suited to NGV technologies.</p>	<p>1) Customer outreach w/NGV products; 2) Train marketing & dealership staff re: NGV opportunity; 3) Consider favorable NGV lease options.</p>	<p>1) Advocate a balanced approach to support alternative fuels, including consideration of well-to-wheel emissions for NG & biomethane; 2) Advocate favorable tariff conditions to make imported NGV technology (components & systems) that are not available in Brazil more cost-competitive as Environmentally Friendly Technologies (EFTs).</p>

Vehicle Manufacturers and NGV System/Equipment Suppliers

YEARS 4 & 5: HDV Program Expansion



ACTIONS	TECHNOLOGY DEVELOPMENT	STANDARDS AND REGULATIONS	MARKETING & COMMUNICATIONS	GOVERNMENT RELATIONS (ADVOCACY & EDUCATION)
<p>THIRD TIMEFRAME ACTIONS Years 4 & 5</p>	<p>Obtain customer feedback to provide improvements & innovations to NGV technologies</p>	<p>Continue working within on-going standards & regulatory development process.</p>	<p>1) Engage in local Brazil Clean Cities program; 2) Support and participate in Blue Corridor or other NGV promotions.</p>	<p>Monitor and advocate favorable terms for domestic content regulations.</p>

STAKEHOLDER ACTION PLAN

Fleet Operators



Fleet Operators

YEAR 1: Laying the Foundations



ACTIONS	VEHICLE OPERATIONS	FACILITIES MANAGEMENT (Fueling & Workshops)	INFORMATION & COMMUNICATIONS	PERSONNEL MANAGEMENT & TRAINING
<p>FIRST TIMEFRAME ACTIONS Year 1</p>	<p>1) Evaluate environmentally friendly alternative fuel options: vehicle availability; new or retrofit; purchase vs lease; best TCO; etc.; 2) Evaluate CNG vs LNG; 3) Consider being an early adopter, NGV Champion Pilot Fleet.</p>	<p>1) Identify and evaluate fueling options (CNG and/or LNG) : on-site fueling cost-benefit analysis vs locally shared fuel station option; fuel stations on frequent routes; range assessment; 2) If on-site maintenance will be done, identify maintenance facility improvements (and costs) required to accommodate gas.</p>	<p>Advocate and communicate with Public Sector (at all levels) for:</p> <ol style="list-style-type: none"> 1. Funding and incentives; 2. Analytic TCO tools from government (and OEMs?); and 3. Standards or regulations to fill gaps for vehicles or fueling. 	<p>Identify training needs for drivers, fueling & maintenance staff.</p>

Fleet Operators

YEARS 2 & 3: Building & Implementation



ACTIONS	VEHICLE OPERATIONS	FACILITIES MANAGEMENT (Fueling & Workshops)	INFORMATION & COMMUNICATIONS	PERSONNEL MANAGEMENT & TRAINING
<p>SECOND TIMEFRAME ACTIONS Years 2 & 3</p>	<p>Develop NGV fleet integration and implementation plan in consideration of growing the NGV fleet component (route planning and fueling on-and-off-site).</p>	<p>1) Initiate workshop upgrades for gas (as may be required), including Standard Operation Procedures (SOPs) for maintenance and fueling (on-site or en-route); 2) If on-site fueling is the chosen option, develop potential expansion plan to accommodate vehicle growth.</p>	<p>1) Apply for and secure loans; subsidies as may be available; 2) Develop information and public relations opportunities to make customers & public aware of innovative and environmental policies of the fleet operator company; 3) Participate as may be possible in any developing Clean Cities programs.</p>	<p>Initiate staff training for drivers, fuel operators and maintenance staff (could be in conjunction with OEM and fuel station provider).</p>

Fleet Operators

YEARS 4 & 5: HDV Program Expansion



ACTIONS	VEHICLE OPERATIONS	FACILITIES MANAGEMENT (Fueling & Workshops)	INFORMATION & COMMUNICATIONS	PERSONNEL MANAGEMENT & TRAINING
<p>THIRD TIMEFRAME ACTIONS Years 4 & 5</p>	<p>Collect fleet & fuel data; (incl. emissions); evaluate TCO; develop long-term AFV adoption plan in accordance with customer requirements (long vs shorter distances for gas and diesel fleet vehicles) with fast-fill and slow-fill options.</p>	<p>On-going data collection, evaluation & monitoring of fleet operations, maintenance, and TCOs.</p>	<p>1) Provide information to customers re: actions & motivation to use NGVs. 2) Develop NGV on-going operational data management; 3), For municipal fleet operators, in particular, consider collaborations to develop central purchase program at national, regional or local level to support the public transport companies in tender preparation and possible cost reduction (with support from public sector).</p>	<p>New staff training as fleet expands.</p>

STAKEHOLDER ACTION PLAN

INFRASTRUCTURE & FUEL STATION SUPPLIERS



INFRASTRUCTURE & FUEL STATION SUPPLIERS

YEAR 1: Laying the Foundations



ACTIONS	TECHNOLOGY & SYSTEMS DEVELOPMENT (also best practices)	FILL GAPS IN STANDARDS & REGULATIONS	STRATEGIC MARKETING & COMMUNICATIONS	ADVOCACY & EDUCATING GOVERNMENT
<p>FIRST TIMEFRAME ACTIONS Year 1</p>	<p>Create user-friendly fuel station measures for HDV fleets to facilitate adoption and use of CNG (remote monitoring; rapid repair services; training etc.).</p>	<p>1) Harmonize & advocate NGV-2 fuel connectors for HDVs (also at selected public stations); 2) Monitor proposed changes in gas composition regulations.</p>	<p>1) Understand (identify) gas network expansion near fleets; 2) Identify best fueling options for fleets: (portable; Mother-daughter virtual pipeline & stationary); 3) Identify large fleets for shared anchor station sites; 4) Identify potential NGV Champion pilot fleets; 5) Consider alternative natural gas pricing strategies to maintain competitiveness with diesel.</p>	<p>1) Advocate for fuel price stability relative to diesel; 2) Advocate policymakers to create attractive financing options, particularly to support fuel station investments; 3) Create fleet data base (coordinate w/OEMs & government).</p>

INFRASTRUCTURE & FUEL STATION SUPPLIERS

YEARS 2 & 3: Building & Implementation



ACTIONS	TECHNOLOGY & SYSTEMS DEVELOPMENT (also best practices)	FILL GAPS IN STANDARDS & REGULATIONS	STRATEGIC MARKETING & COMMUNICATIONS	ADVOCACY & EDUCATING GOVERNMENT
<p>SECOND TIMEFRAME ACTIONS Years 2 & 3</p>	<p>1) Develop modular station designs & strategies (cookie cutter approach); 2) Work w/ biomethane providers to provide 'green gas' for NGV fueling stations.</p>	<p>1) Provide input to develop LNG station & fuel connector standards; 2) Advocate adoption and wide-spread use of fuel station road signage (UNECE-approved signage).</p>	<p>1) Coordinate station roll-outs with gas & vehicle providers; 2) Develop L-CNG station options (if LNG is available); 3) Create NGV 'Port' plan for airport and seaport fuel and truck integration (also working with gas industry stakeholders).</p>	<p>Continue on-going site visits & meetings w/policy makers & customers.</p>

INFRASTRUCTURE & FUEL STATION SUPPLIERS

YEARS 4 & 5: HDV Program Expansion



ACTIONS	TECHNOLOGY & SYSTEMS DEVELOPMENT (also best practices)	FILL GAPS IN STANDARDS & REGULATIONS	STRATEGIC MARKETING & COMMUNICATIONS	ADVOCACY & EDUCATING GOVERNMENT
<p>THIRD TIMEFRAME ACTIONS Years 4 & 5</p>	<p>Continue on-going market research and training w/fleet customers and fuel station operators.</p>	<p>Monitor and provide refinements, additions & amendments to standards & regulations as may be necessary (also working with gas industry stakeholders).</p>	<p>1) On-going communications with fleet customers and fuel station operators to determine improvements and best practices; 2) Expand outreach efforts to smaller and independent fleet operators.</p>	<p>Develop longer term infrastructure planning for biomethane, LNG, L-CNG, pipeline and virtual pipeline expansion along corridors and urban centers yet-to-be-reached by gas service.</p>

STAKEHOLDER ACTION PLAN CIVIL SOCIETY



CIVIL SOCIETY

YEAR 1: Laying the Foundations



ACTIONS	TECHNOLOGY & SYSTEMS DEVELOPMENT (also best practices)	FILL GAPS IN STANDARDS & REGULATIONS	STRATEGIC MARKETING & COMMUNICATIONS	POLICY ADVOCACY , EDUCATING & TRAINING
<p><i>(Timeframes not applied as most involvement and work is on-going)</i></p> <p>TRADE & INDUSTRY ORGS/NGOs</p>	<p>1) Identify vehicle availability and match to fleet vehicle preferences; 2) Evaluate cost/benefits, TCO as well as OEM and customer views of introducing lightweight CNG cylinders to Brazil.</p>	<p>Advocacy & involvement in standards & regulations development (L-NGVs; LNG Small Scale production; biomethane injection in pipeline.</p>	<p>1) Work with public sector and stakeholders on NGV needs, strategies, incentives & funding opportunities; 2) Identify potential early adopters, NGV Champion pilot fleets.</p>	<p>1) Engagement in government High Level Stakeholder Working Group on NGVs; 2) Advocate for data bases (fuel stations & vehicles); 3) Identify info & training needs for fleets (& public); 4) Analyze tariff implications on NGV industry market development including tariff exemptions for Environmentally Friendly Technologies not available in Brazil.</p>

CIVIL SOCIETY

YEARS 2 & 3: Building & Implementation



ACTIONS	TECHNOLOGY & SYSTEMS DEVELOPMENT (also best practices)	FILL GAPS IN STANDARDS & REGULATIONS	STRATEGIC MARKETING & COMMUNICATIONS	POLICY ADVOCACY , EDUCATING & TRAINING
<p>UNIVERSITY & ANALYSTS (including consultants)</p>	<p>1) Initiate surveys & focus groups on fleet & fuel station best practices; 2) Analyze TCO & emissions impacts; 3) Identify research and development (R&D) gaps & needs.</p>	<p>1) Assist in assessing gaps & needs for standards & regs (LNG/biomethane); 2) Evaluate potential for harmonized energy units to sell alternative fuels.</p>	<p>1) On-going assessments of Blue Corridors and hub & spoke fuel station strategies; 2) Conduct on-going NGV/AFV policy impact analyses of cost-benefits and environmental impacts; 3) Analyze early adoptor, NGV Champion pilot fleets to present findings & conclusions at public fora; 4) Help encourage, develop and engage in Clean Cities programs.</p>	<p>1) Identify training needs for fleet & fuel station operators; 2) Create NGV training & support institutions, including CNG cylinder inspection training for lightweight cylinders.</p>

ANNEX 2

EFFECTIVE DISSEMINATION OF THE ROADMAP TO SPEED IMPLEMENTATION



Roadmap do Mercado Brasileiro de
VEÍCULOS PESADOS A GNV

Achieving the goals of the Roadmap through its dissemination.

- Who should receive it?
- What are the key messages of transmittal?
- How to deliver the Roadmap.

Helping to Achieve the Roadmap Goals through Dissemination of the Plan:

- **Who should receive the Roadmap?**
 - *All the stakeholders involved in the development of the Roadmap. Reward/confirm their involvement.*
 - *Make the Roadmap available on-line*
- **What are the key messages when sharing the Roadmap with the stakeholders & public?**
 - The Roadmap **serves as a *guideline*** but must be *flexible* to be modified as determined appropriate or desirable by policy makers *with input from the stakeholders*.
 - *Your government is working to improve the environment, deal with climate change, and provide affordable energy options for the transport sector.*

HOW TO 'DELIVER' THE ROADMAP

1. Disseminate the Roadmap (*and the library of resource documents*) amongst policy makers (horizontally) **AND** with all the stakeholders involved in the Roadmap process.
2. Make the Roadmap available on-line along with other government information/documents.
3. Announce the Roadmap publicly through the 'usual' media channels – social & commercial.

ANNEX 3

NGV DOCUMENT RESOURCE LIBRARY FOR BRAZIL STAKEHOLDERS

Background & Support to Roadmap (Listing of Topic Content)

EXPLANATION OF SUPPORTING DOCUMENT FILES

- The *Document Resource Library*, separate from Part 1 and Part 2 of the main Roadmap, is intended to list and, in some cases, link various sources and documents that could be useful to Brazil policy makers and stakeholders in moving forward with heavy duty natural gas trucks and busses.
- Original documents are provided in separate files comprising the companion ‘library’ of relevant information
- The ‘contents’ of the library are listed below, grouped in specific categories of subjects that correspond to separate pdf document files provided. Because website links frequently change, making documents unavailable, copies of most documents are provided directly in order to create an actual resource library rather than one only linked to the internet. In some cases where links are provided, they are as existed in July 2021.



Roadmap do Mercado Brasileiro de
VEICULOS PESADOS A GNV

NGV DOCUMENT RESOURCE LIBRARY FOR BRAZIL STAKEHOLDERS*

Background & Support to Roadmap

- *Explanation of Supporting Documents (previous slide)*
- Analytic Models (4)
- Biomethane Decision Makers Guides (2)
- CNG Cylinder Safety & Inspections (5)
- CO₂ Policy Documents-Europe (2)
- Fuel Strategies & Best Practices (1)
- Gas Composition, Quality & Reference Fuels (8)
- Measurement Units for Public Display of Methane Prices-Gasoline & Diesel Gallons/Liters Equivalencies (4)
- Maintenance Facility Safety (2)
- United Nations Economic Commission for Europe (UNECE) Regulations for NGVs (links to 8 regulations)
- Existing European/ISO Standards for Fuel Stations (links to 3 regulations. Note: These are 'freely available' but may not be available 'for free'.)

*(Numbers in parentheses) indicate number of documents provided in each category.