

F R O S T & S U L L I V A N



# Strategic Analysis of Global Hybrid and Electric Heavy-Duty Transit Bus Market

By 2020 15 Percent of Heavy-Duty Transit Buses Sold to Feature Hybrid/Electric Drive

**Concise Summary of Study Featuring  
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**NC7C  
Aug 2013**



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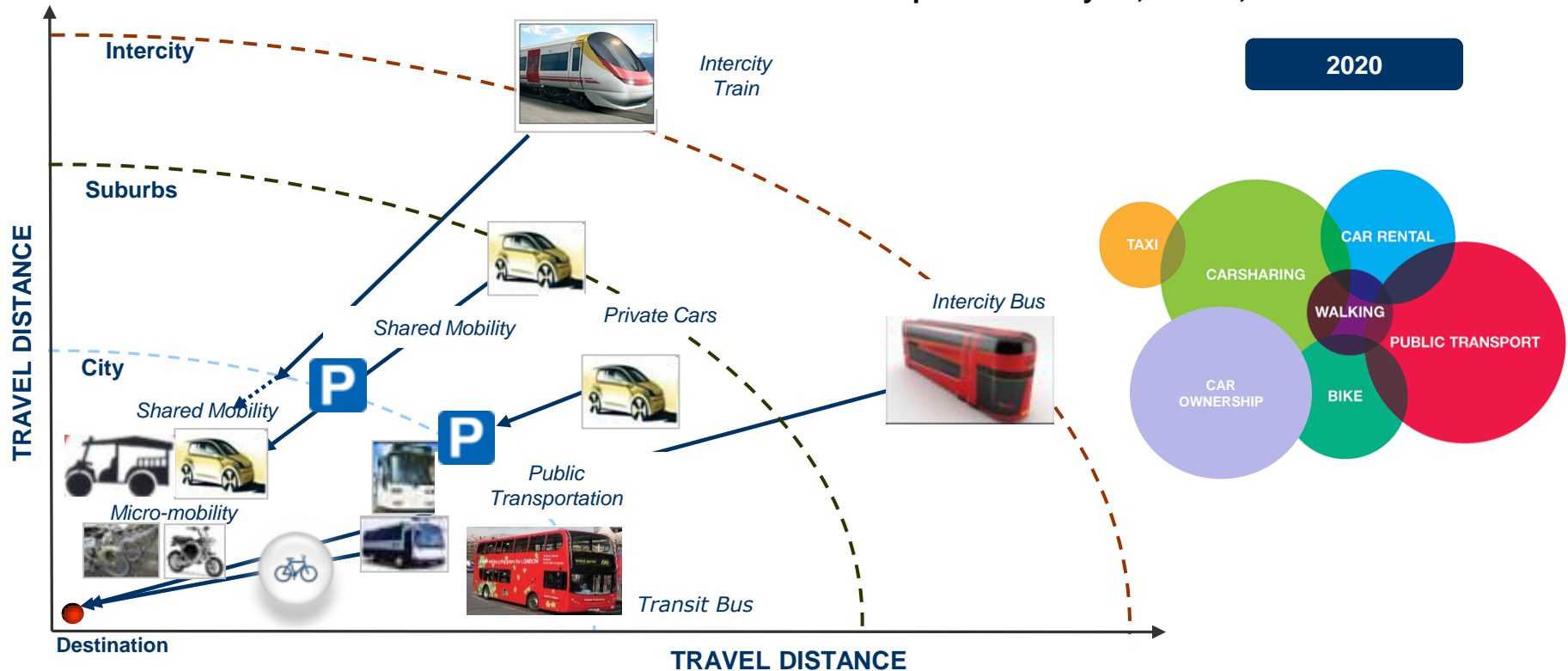
# Executive Summary



# Executive Summary: Integrated Mobility

Future of Urban Transportation is Multimodal Commuting, Combining Door-to-Door Solutions Using Dedicated Mobility Platforms

H&E HD Transit Bus Market: Transit Solutions Comparative Analysis, Global, 2020



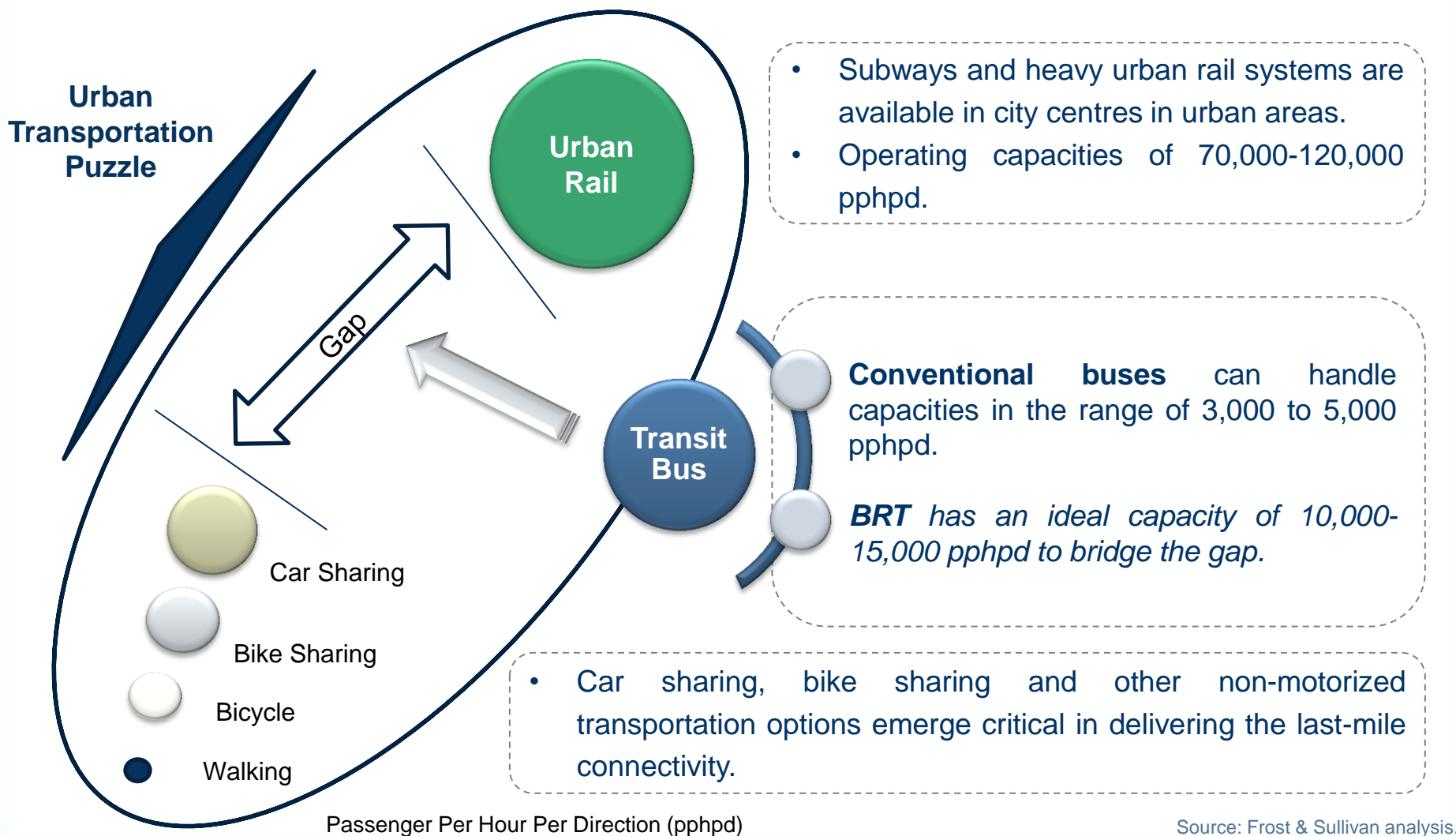
- Door-to-door integrated, multimobility a reality in future
- Vehicle manufacturers to offer smart mobility solutions ensuring first- and last-mile connectivity.
- Government to combine public transport with bike / two-wheeler/car-rental schemes
- Market will see new players in market termed as **“Mobility Integrators”**

Source: Frost & Sullivan analysis.



# Executive Summary: Integrated Mobility

10,000 to 15,000 pphpd Capacity that HD Transit Buses and BRT Provide Can Bridge the Gap Between High-Capacity Upstream Urban Rail Systems and Low-Capacity Downstream Transportation Options.



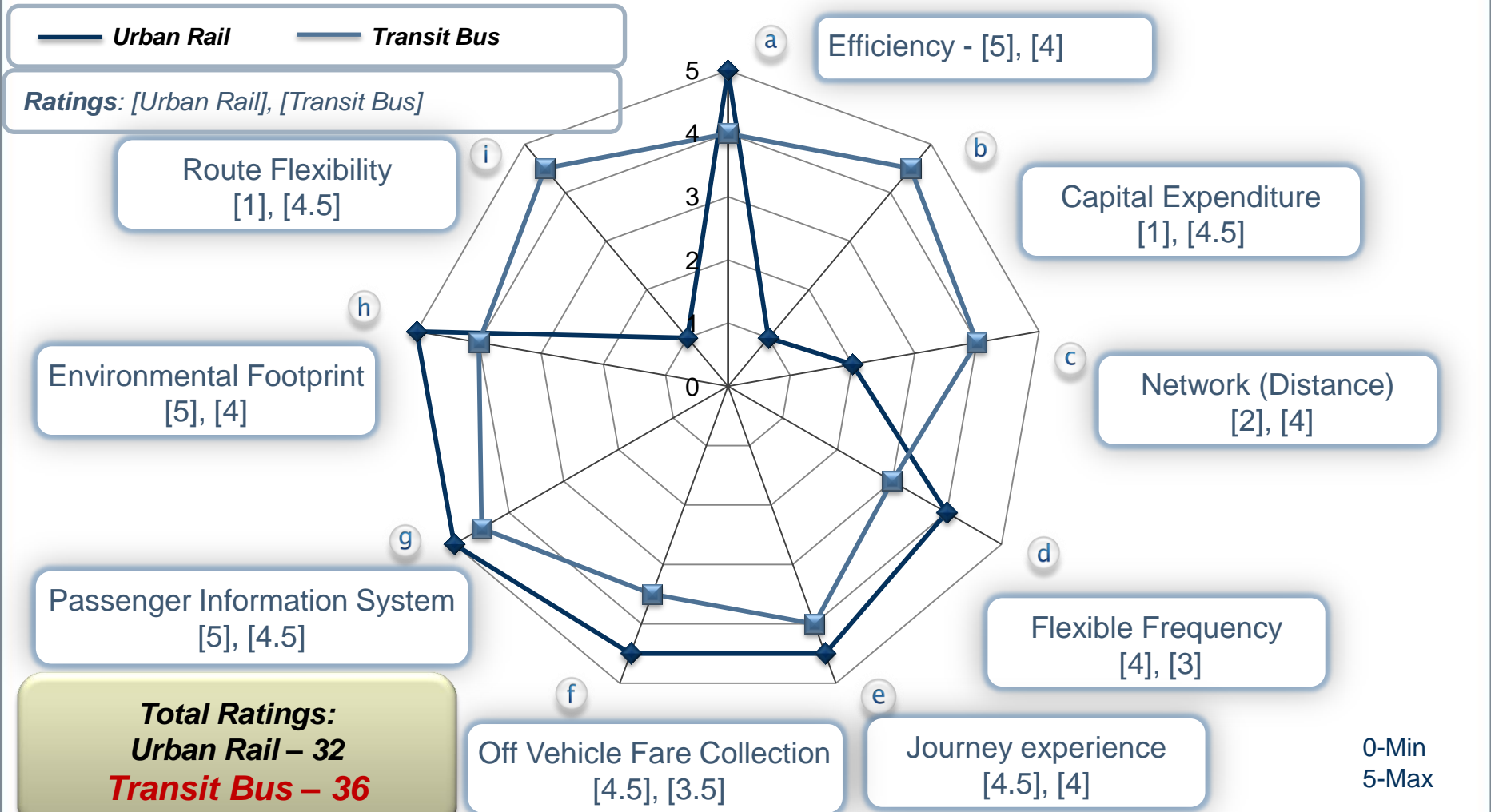
Source: Frost & Sullivan analysis.



# Executive Summary: Comparison Between Transit Bus and Urban Railway Systems

Transit Bus System Emerges as a Sustainable Solution For Both Developed and Developing Economies, with Relatively Lower Capital Expenditure and High Route Flexibility Compared to Railway System

H&E HD Transit Bus Market: Transit Solutions Comparative Analysis, Global, 2012



Note: All figures are rounded; the base year is 2011. Source: Frost & Sullivan analysis.



# Executive Summary: H&E HD Transit Bus Market—Key Influencing Trends

Lowest Pressure on Existing Energy Infrastructure and Lower Emissions Relative to CNG/LNG Buses Will Catalyze Relevance and Prevalence of Hybrid Buses for Urban Mobility Through the Forecast Period and Beyond

## H&E HD Transit Bus Market: Key Influencing Trends, Global ,2012-2020

### Urbanization and Congestion

- Low emission zones
- Low cost and quick mass transport
- Connectivity between multiple points in city and suburbs

### Regulatory Environment

- Legislations mandating greener transport solutions
- Subsidies for electric/hybrid/ alternate fuel vehicles
- Strict fuel efficiency targets

### Energy Storage modules

- Rapid technological advancements
- Falling module prices
- Increased production capacity

### Energy Security

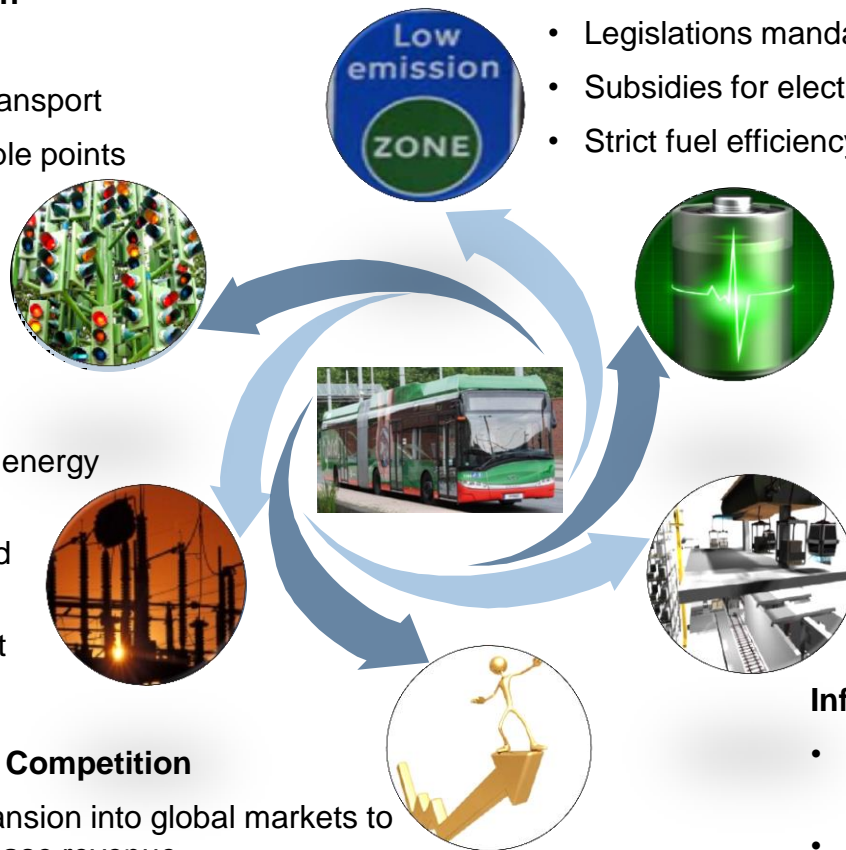
- Reducing dependency on energy import
- Adoption of renewable and alternate energy
- Drive towards fuel efficient vehicles

### Global Competition

- Expansion into global markets to increase revenue
- Develop innovative transit solutions to stay ahead of competition

### Infrastructure development

- Investment in charging infrastructure
- Preference for BRT system
- Off-board ticketing system



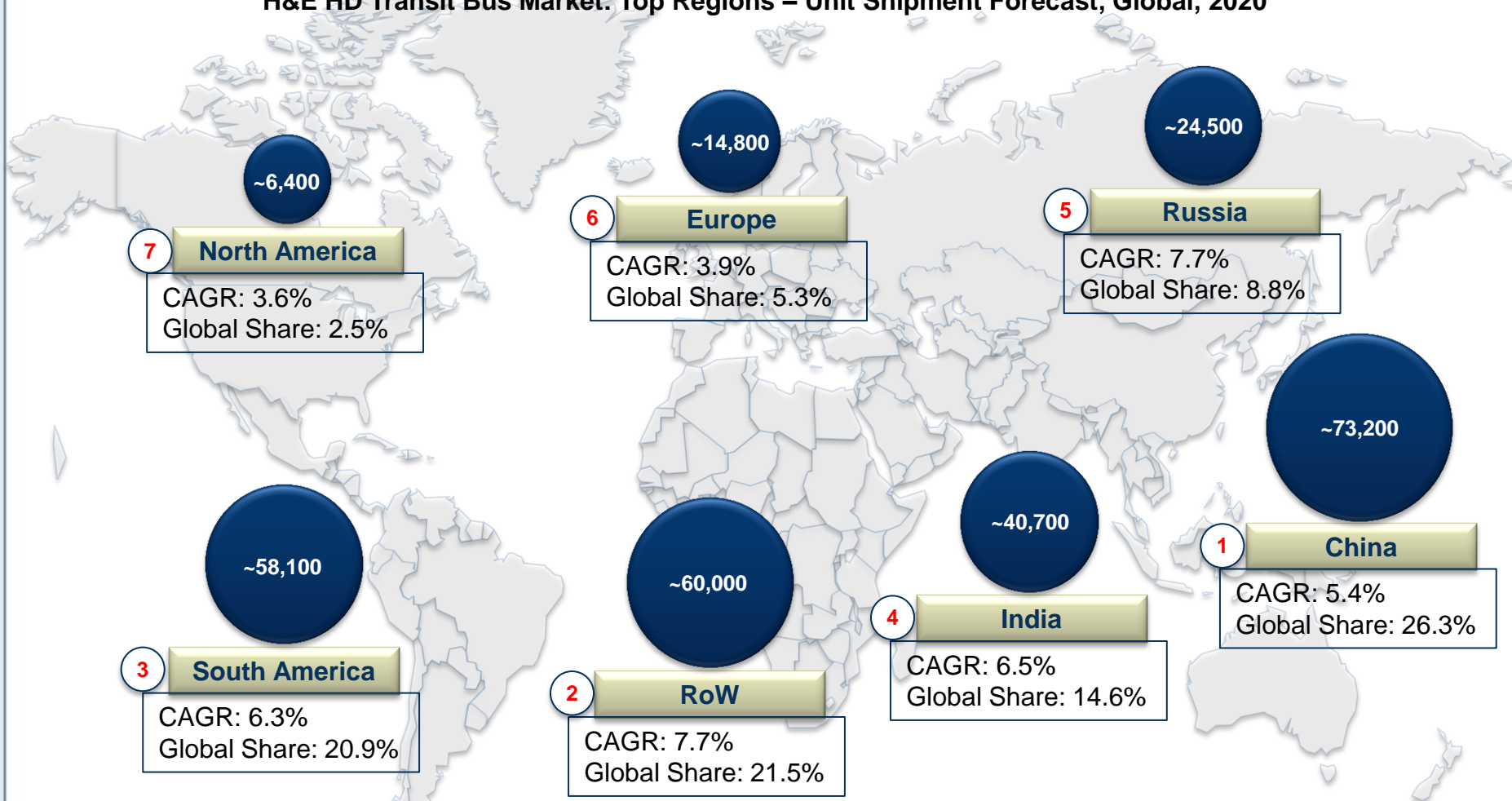
Source: ECLAC and Frost & Sullivan analysis.




# Executive Summary: Snapshot of Global HD Transit Bus Market – 2020

BRIC Nations to Lead Growth; However The RoW Markets such as Africa and ASEAN are Expected to Gain Significance as they Migrate Towards Economical and Flexible Urban Transportation Solutions

H&E HD Transit Bus Market: Top Regions – Unit Shipment Forecast, Global, 2020



Size of ball denotes the 'HD Transit Bus' market size by unit volume in respective regions.

 Ranking of region as per market size 'H&E Transit Bus'

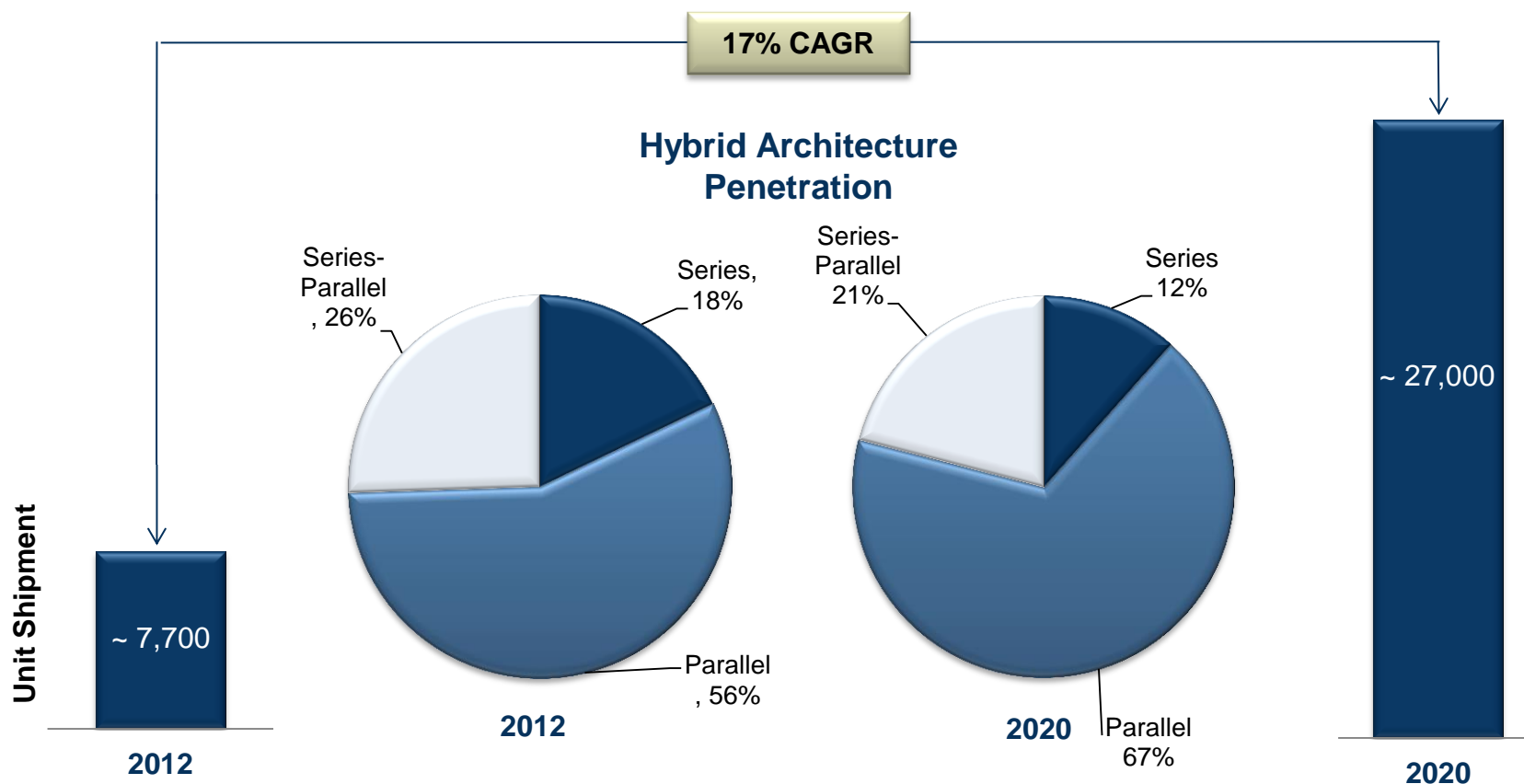
Source: Frost & Sullivan analysis.



# Executive Summary: Hybrid Transit Bus – Penetration by Hybrid Architecture

Parallels to Dominate the Global Hybrid Powertrain Market as Tough Economic Situation will Influence Buying Decisions Towards Low Cost Solutions. Top Hybrid Module Suppliers are Expected to Launch Parallel System.

H&E HD Transit Bus Market: Market Share by Hybrid Architecture, Global, 2012 -2020









Note: All figures are rounded; the base year is 2012. Source: Frost & Sullivan analysis.



# Executive Summary: Region Wise Price Comparison for Transit Buses

China to Feature Most Competitively Priced Hybrid/Electric Transit Buses; Prices for Both Conventional and Alternative Powertrain Propelled Transit Buses Were Found Highest in TRIAD Markets

## H&E HD Transit Bus Market: Regional Market Price Scenario, Global, 2012

| Market   | Conventional (Diesel) | Hybrid              | Electric            |
|--|-----------------------|---------------------|---------------------|
|   | \$200,000-\$225,000   | \$280,000-\$340,000 | \$410,000-\$500,000 |
|   | \$60,000-\$90,000     | \$125,000-\$200,000 | \$280,000-\$350,000 |
|   | \$75,000-\$110,000    | \$175,000-\$255,000 | \$325,000-\$410,000 |
|   | \$300,000-\$400,000   | \$485,000-\$540,000 | \$595,000-\$690,000 |
|   | \$250,000-\$350,000   | \$420,000-\$510,000 | \$575,000-\$680,000 |
|  | \$130,000-\$180,000   | \$245,000-\$325,000 | \$400,000-\$500,000 |
| RoW  | \$100,000-\$350,000   | \$195,000-\$500,000 | \$300,000-\$700,000 |

 Major Low cost markets

 Major High cost markets

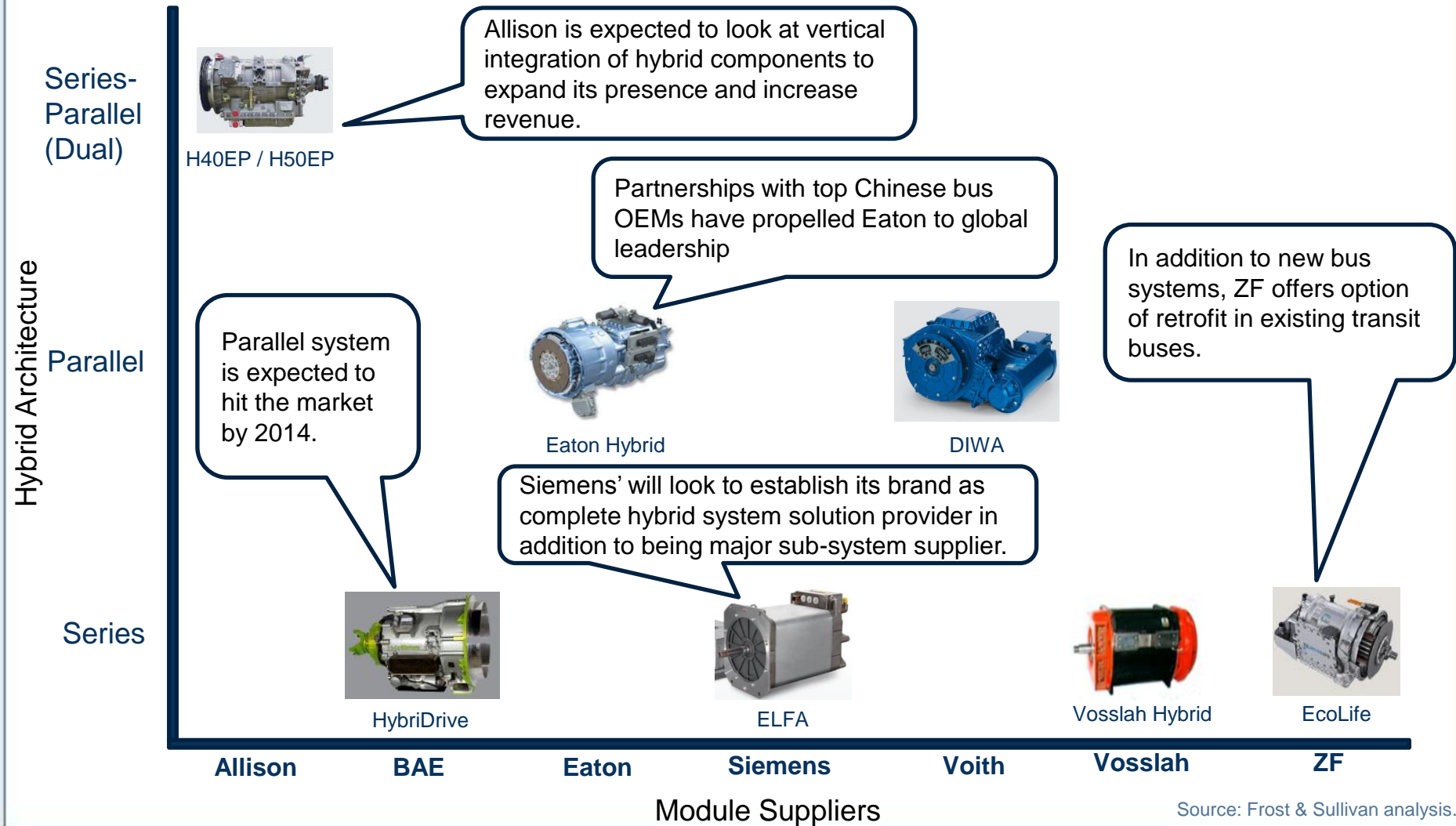
Source: Frost & Sullivan analysis.



# Executive Summary: Global Hybrid Module Supplier Product Mapping

Participants to Increasingly Focus on Parallel Module with 3 Major Suppliers Likely to Introduce it by 2014.  
Chinese Module Integrators are Poised to Capture Significant Market Volume, however restricted to China.

## H&E HD Transit Bus Market: Hybrid Module Product Mapping, Global, 2012









Source: Frost & Sullivan analysis.



# Executive Summary: Transit Bus Powertrain & Energy Storage Standard

Parallel Hybrids are Expected to Strengthen its Market Position Due to the Cost Advantage Over Other Systems. UCs and UC Hybrid to Gain Prominence as Primary Energy Storage System, Especially in Hybrid Buses.

## H&E HD Transit Bus Market: Green Powertrain & Energy Storage Standard Overview, Global, 2012-2020

| Region   | New Energy Powertrains |               |                        |               | Energy Storage Technologies |                  |                       |           |
|--|------------------------|---------------|------------------------|---------------|-----------------------------|------------------|-----------------------|-----------|
|  | Parallel Hybrid        | Series Hybrid | Series-Parallel Hybrid | Pure Electric | Ni-Mh Batteries             | Li-ion Batteries | Ultracapacitors (UCs) | UC Hybrid |
|    | ✓ ↑                    | ↑             | ↑                      | ↑             | ↑                           | ↑                | ↑                     | ↑         |
|    | ✓ ↑                    | ✓ ↑           | ✓ ↑                    | ✓ ↑           | ✓ ↑                         | ✓ ↑              | ✓ ↑                   | ✓ ↑       |
|    | ↑                      | ✓ ↑           | ✓ ↑                    | ↑             | ✓ ↑                         | ✓ ↑              | ✓ ↑                   | ↑         |
|    | ✓ ↑                    | ✓ ↑           | ✓ ↑                    | ✓ ↑           | ✓ ↑                         | ✓ ↑              | ✓ ↑                   | ✓ ↑       |
|   | ↑                      | ↑             | ↑                      | ↑             | ↑                           | ↑                | ↑                     | ↑         |
|  | ↑                      | ↑             | ↑                      | ↑             | ↑                           | ↑                | ↑                     | ↑         |
| RoW  | ↑                      | ↑             | ↑                      | ↑             | ↑                           | ↑                | ↑                     | ↑         |

✓ Market in 2012    ↑ Strong Trend Towards 2020

↑ Moderate Trend Towards 2020

— NA

Source: Frost & Sullivan analysis.



## Executive Summary: Key Regional Focal Points for OEMs

Original Equipment Manufacturers (OEMs) Should Look at Developing Independent Market Entry Strategies for Different Regions.

### H&E HD Transit Bus Market: Regional Market Scenario, Global, 2012

| Market        | Ride Cost/trip | Operational Subsidy       | Vehicle Price (12 m) | Customer Types  | Key OEM Focal Points   |
|---------------|----------------|---------------------------|----------------------|---|--|
| Latin America | \$0.75-\$1     | No subsidy                | \$200,000-\$225,000  | Private operators                                       | <ul style="list-style-type: none"> <li>Financing and leasing</li> <li>Localized assembly</li> </ul>  |
| China         | \$0.25-\$0.30  | Subsidized                | \$60,000-\$90,000    | Public (state purchase and leased to private operators) | <ul style="list-style-type: none"> <li>Product quality (life cycle enhancement)</li> <li>Localized assembly</li> <li>Advanced powertrain technologies</li> </ul> |
| India         | \$0.2/stage    | Subsidized                | \$100,000-\$125,000  | Public (state operator)                                 | <ul style="list-style-type: none"> <li>Product quality</li> <li>STU collaboration</li> </ul>   |
| North America | \$1-\$5        | Subsidized                | \$300,000-\$400,000  | Public (local transit agency)                           | <ul style="list-style-type: none"> <li>Advanced powertrain development</li> <li>Reduced product delivery time</li> </ul>   |
| Europe        | \$1.5-\$4.0    | Subsidized                | \$250,000-\$350,000  | Public (local transit agency)                           | <ul style="list-style-type: none"> <li>Advanced powertrain development</li> </ul>  |
| Russia        | \$0.75-\$0.83  | Subsidized                | \$130,000-\$180,000  | Public (local transit agency)                           | <ul style="list-style-type: none"> <li>Localized assembly</li> <li>Collaboration with local OEMs</li> </ul>  |
| Rest of World | \$0.5-\$10     | Subsidized/<br>no subsidy | \$100,000-\$350,000  | Public/private  | <ul style="list-style-type: none"> <li>Distribution and after-sales network</li> </ul>   |

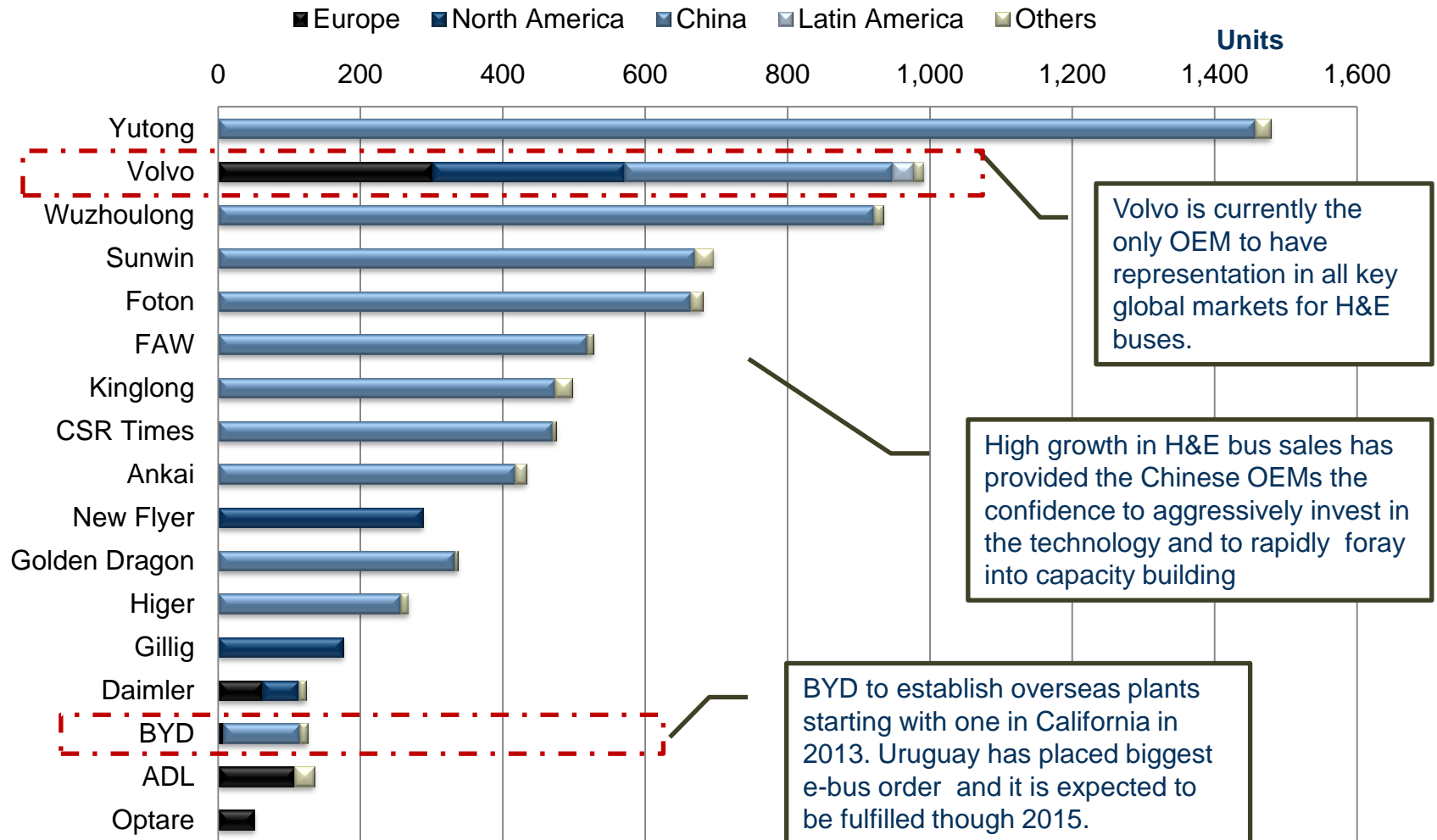
Source: Frost & Sullivan analysis.



# Executive Summary: H&E Transit Bus OEMs – Unit Shipment 2012

Yutong Led the Global H&E Bus Market. Volvo's Global Footprint Enabled it to Sell Nearly One Thousand Units

H&E HD Transit Bus Market: Unit Shipments by OEMs, Global, 2012



Note: All figures are rounded; the base year is 2012. Source: Frost & Sullivan analysis.



# Executive Summary: Key Research Findings

## H&E HD Transit Bus Market: Key Research Findings, Global, 2012-2020

1

The global HD transit bus market is set to reach ~ 280,000 units by 2020 with a CAGR of 6.4 percent over the 2012-2020 forecast period. China and Latin America will contribute 47.2 percent of global volumes.

2

By 2020, market penetration of hybrid transit buses is expected to reach 9.8 percent, while that of electric buses is expected to be 5.4 percent. The combined market size is forecasted to be ~ 42,000 units growing at a CAGR of 20.8 percent.

3

Chinese manufacturers such as Yutong, Wuzhoulong, Foton, and Kinglong are expected to top the global hybrid and electric transit bus market. Volvo, ADL and Daimler will feature as non-Chinese members of the top-10 H&E (hybrid & electric) transit bus OEMs by unit volumes. Vertical integration efforts to be increasingly pursued by Western OEMs while Eastern OEMs will develop synergistic relationships with Tier-1 suppliers of powertrain systems.

4

By 2020, parallel hybrid systems will strengthen its market share from 56 percent in 2012 to about 67 percent, and remain the most prevalent hybrid powertrain architecture. Market dominance by Eaton, Allison and BAE is expected to be challenged by as ZF, Siemens and new Chinese hybrid integrators such as Fugong and Santroll.

5

Globally, more than 250 Bus Rapid Transit (BRT) lines are operational or under various stages of implementation. This translates into enormous market potential for new vehicle purchase and replacement demand, especially for H&E buses.



# Research Objective, Methodology, Background, and Scope



# Research Scope

|                 |  |
|-----------------|--|
| Base Year       | 2012   |
| Study Period    | 2012 to 2020   |
| Forecast Period | 2013 to 2020   |
| Vehicle Type    | Hybrid and Electric (H&E) buses, H&E Transit buses and BRT buses<br>(Above 10 meters length) |

## Geographic Regions

The regional markets covered in this research service are:

- **North America** consists of United States and Canada
- **Europe** consists of Western Europe, Central Europe, Eastern Europe (excluding Russia and Turkey)
- **China**
- **India**
- **Russia**
- **Latin America** consists of Central America and South America
- **Rest of World** consists of Africa, Middle East (including Turkey), Rest of Asia (excluding China and India), and Oceania (Australia and New Zealand).

Source: Frost & Sullivan research.



# Research Aims and Objective

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## Aim

The aim of this research study is to provide executive analysis of growth opportunities in the Global H&E Heavy-duty (HD) Transit Bus Market.

## Objectives

1. Provide strategic overview of key megatrends and market engineering metrics.
2. Provide market drivers, restraints, and opportunities.
3. Provide forecasts for the total transit bus market in key global markets.
4. Provide forecasts of the H&E HD transit bus market.
5. Provide insight on future technologies determining the growth of the market
6. Provide market share analysis for overall and constituent markets.
7. Develop an actionable set of recommendations for market entry and growth.

Source: Frost & Sullivan research.



# Research Background

This research study is a short summary capturing content from various of our recently published and on-going research in the areas of global commercial vehicle powertrain, chassis, safety, telematics, and regulation compliance technologies and markets

- **NA5E-18** Strategic Analysis of the Global Bus Rapid Systems Market – **Completed**
- **N9FF-18** Strategic Analysis of Medium-Heavy Duty Hybrid/Electric Truck and Bus Market in North America and South America – **Completed**
- **M783-18** Strategic Analysis of Medium-Heavy Hybrid/Electric Truck and Bus Markets in EMEA Region– **Completed**
- **M8D2-18** Strategic Analysis of MD-HD CNG/LNG Truck and Bus Market in Western Europe–**Completed**
- **N8CF-18** Strategic Analysis of Class 6-8 Natural Gas Truck Market in North America - **Completed**
- **N998-18** Strategic Analysis of Brazilian Commercial Truck Market - **Completed**
- **N8E4-18** Strategic Analysis of Class 4-8 Truck Safety Technologies Market in North America– **Completed**
- **NA53-18** Strategic Analysis of Global Platforms of Major Heavy-duty Truck Manufacturers– **Completed**
- **P4F1-18** Strategic Analysis of Indian Commercial Vehicle Market- **Completed**
- Strategic Analysis of Medium-Heavy Hybrid/Electric Truck and Bus Markets in China and India – **Completed**
- **NAAF-18** Strategic Analysis of Powertrain Downsizing Strategies of Major Heavy Duty Truck Manufacturers in North America – **Completed**

**This study is also supplemented by our on-going continuous interactions with vehicle manufacturers and suppliers, for alternative powertrain technologies, among other truck technologies**

Source: Frost & Sullivan research.



# Research Methodology

## Research Methodology

Frost & Sullivan’s research study is based on secondary and primary research data.

**Secondary Research:** Extraction of information from existing reports and project material within the F&S database, to include data and information gathered from technical papers, specialized magazines, seminars and internet research.

**Primary Research:** Over **35** interviews have been conducted over phone by senior consultants/industry analysts with original equipment suppliers, regulation authorities and distributors. Primary research has accounted for 80% of the total research.

**H&E HD Transit Bus Market: Partial List of Industry Participants, Global, 2012**

| North America                        | Europe                        | Asia  |
|--------------------------------------|-------------------------------|---|
| New Flyer of America (New Flyer)     | Volvo Bus Corporation (Volvo) | Zhengzhou Yutong Group Co., Ltd. (Yutong)         |
| North American Bus Industries (NABI) | Daimler Buses (Daimler)       | Shenzhen Wuzhoulong Motors Co., Ltd. (Wuzhoulong) |
| Gillig Corporation (Gillig)          | Iris Bus (IVECO)              | Anhui Ankai Automobile Co., Ltd (Ankai)           |
| Nova Bus (Nova)                      | MAN Trucks & Bus (MAN)        | Shanghai Sunwin Bus Corporation (Sunwin)          |
| Sinautec Automobile Technologies     | Solaris Bus (Solaris)         | Foton AUV (Foton)                                 |
| BAE Systems                          | Alexander Dennis Ltd., (ADL)  | Build Your Dreams (BYD)                           |
| Allison Transmission                 | ZF                            | Tata Motors (TM)                                  |
| Eaton                                | Siemens                       | Ashok Leyland Ltd., (AL)                          |

Source: Frost & Sullivan research.



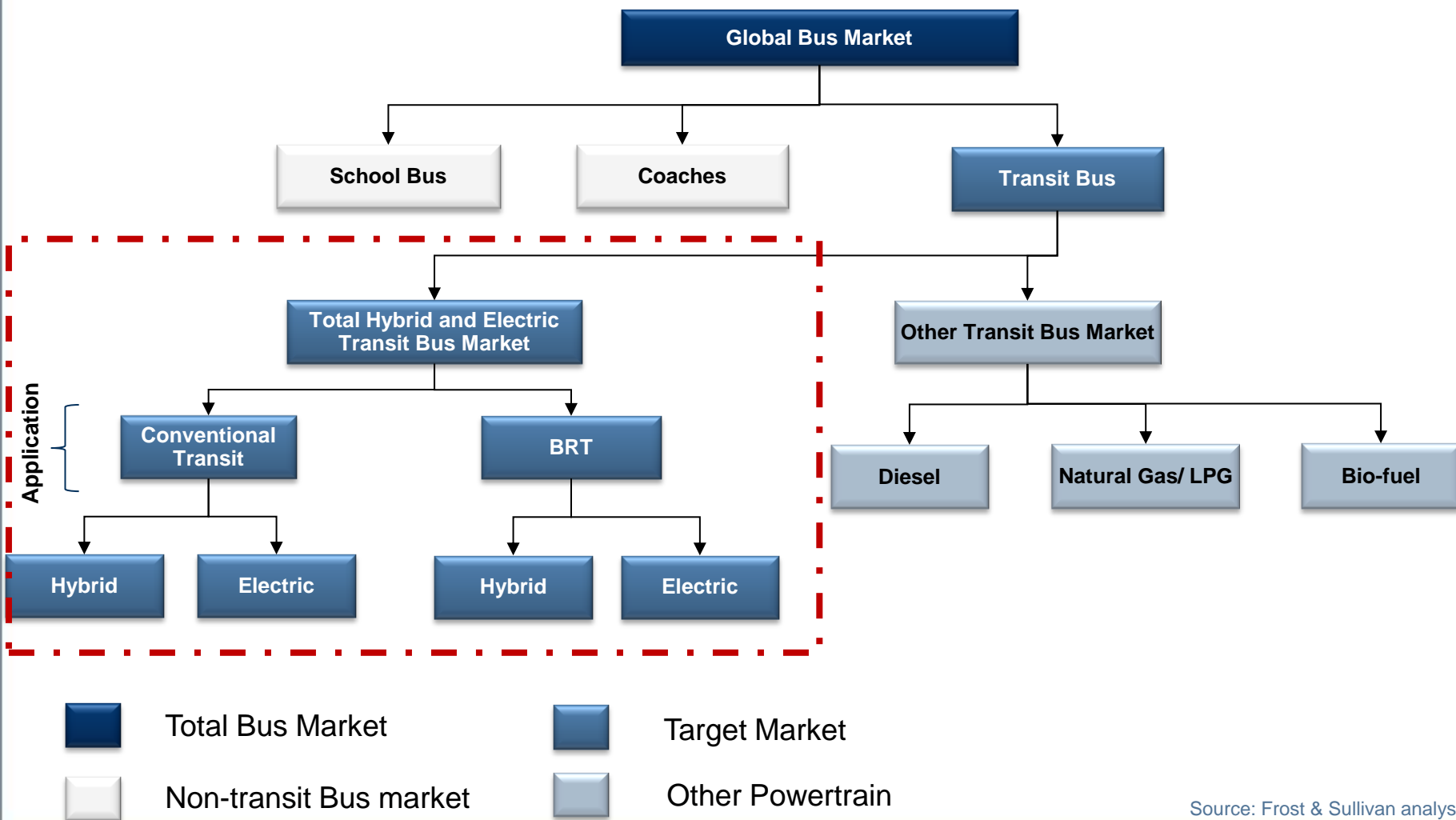
# Definitions and Segmentations



# Market Segmentation

This Study Focuses on Global Heavy-Duty Hybrid and Electric Transit Bus Market

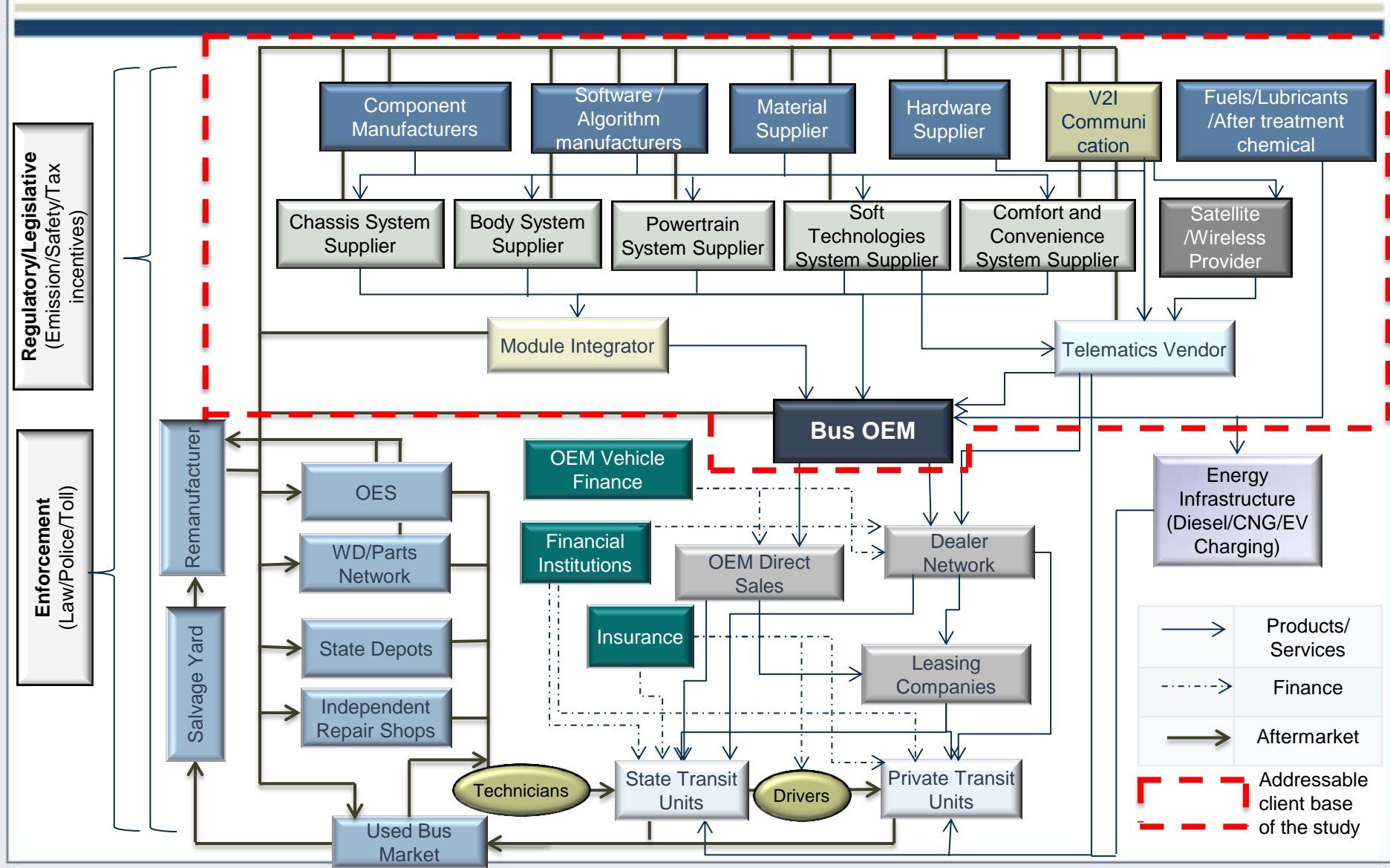
## H&E HD Transit Bus Market: Bus Market Segmentation, Global, 2012



Source: Frost & Sullivan analysis.



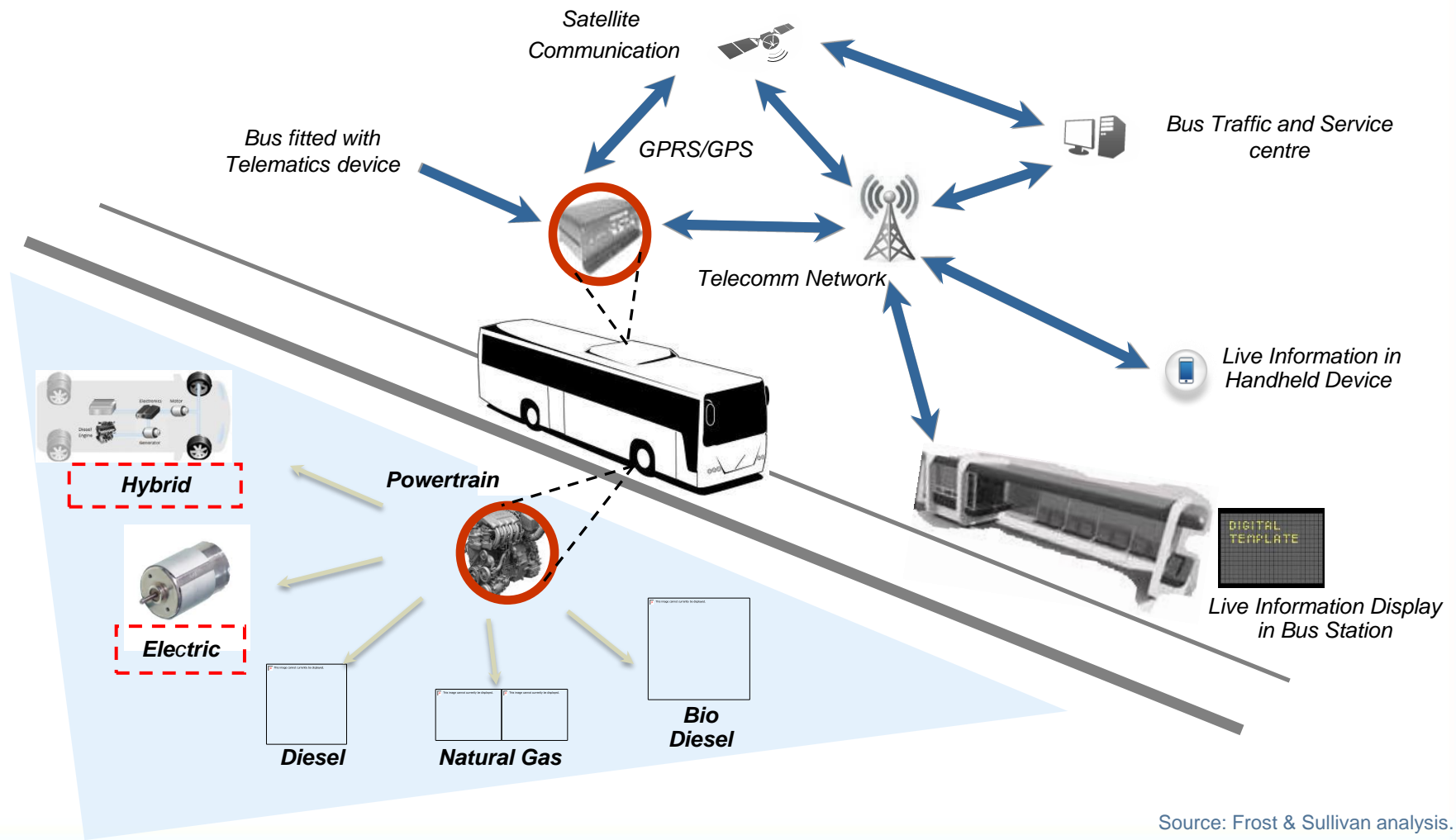
# Market Structure





# Schematic of a Functional Transit Bus System

H&E HD Transit Bus Market: Functional Schematic, 2012



Source: Frost & Sullivan analysis.



## Definitions:

HD Transit Bus – GVWR Above 8 Tonne (or) Length Greater than 10 Metres

### Transit Bus

Transit buses refer to buses that are intended for transporting the public within intra city routes. These buses can have a wide range of GVWRs and passenger carrying capabilities (including para transits and disabled transportation), but they are normally purchased by public organizations.



### Bus Rapid Transit (BRT)

A high-quality bus-based transit system that combines stations, vehicles, services, running ways, and Intelligent Transportation System (ITS) elements into an integrated system with a strong positive identity and unique image. Buses which ply on these systems are BRT buses



### Hybrid Transit Bus

- Hybrid systems have a primary diesel engine coupled with a generator-motor system. The primary engine can also be powered by compressed natural gas (CNG).
- Hybrid vehicles offer higher fuel efficiency compared to similar diesel powered vehicle.



### Electric Transit Bus

- This includes battery buses, electric trolley buses, and fuel-cell buses used for transit applications.
- Zero tail pipe emission is a key attribute to these vehicles.





# Market Engineering Methodology

One of Frost & Sullivan's core deliverables is its Market Engineering studies. They are based on our proprietary Market Engineering Methodology. This approach, developed across 50 years of experience assessing global markets, applies engineering rigor to the often nebulous art of market forecasting and interpretation. A detailed description of the methodology can be found [here](#).



Source: Frost & Sullivan research.