Qatar Education City People Mover System – for Innovative and Environmentally Friendly Mobility
Complete rail solutions
Advantages of turnkey projects vs. "single lot" approach
Complete rail solutions
Advantages of turnkey projects vs. "single lot" approach

Advantages of a turnkey project
Everyone works toward the same goal!

- A single contract with the customer for all services
- The contractor becomes a partner
- The contractor must have sufficient experience and be financially robust
- No competing lots – they all carry the risk together
- No integration risk for the customer
- The contractor is entirely responsible for the fulfillment of technical requirements
- Less potential for delays
- Easier to finance
Complete rail solutions
Advantages of turnkey projects vs. "single lot" approach

- Integrated project is the common goal
- Full aligned with customer’s targets
- Less changes, less risks
- Functionality drives design
- Fast execution

Various goals
- Alignment is an issue; too many interests
- Scattered functionality

- Many changes, more risks for all
- No automatic alignment; delays are the rule

Siemens offers more than just system integration

### Advantages of a turnkey project with Siemens

- Project management, system integration, coordination and technical solutions from a single source
- High-performance rail systems (vehicles, signaling systems, traction power supply and other infrastructure) from Siemens with proven interfaces
- Experienced employees with optimized processes and tools for implementation
- Customer training and customer support / consulting during commencement of operation
- Global maintenance and service organization for rail systems and infrastructure guarantee we are always close at hand for the customer during operation
- Support with project financing
- Financial strength
- Also successful in consortia with external partners
- Extensive global experience / references

### Customer benefits

**Satisfied passengers and operators**

- Fulfillment of the highest safety standards for operation
- We have repeatedly proven the high performance and reliability of the integrated systems installed by us
- Optimized life cycle costs and our extensive range of maintenance services and other services can be scaled according to the customer's wishes
Turnkey references worldwide

- **Light rail system**
- **Metro**
- **Val**
- **Airport link**
- **High speed + interurban**

- **Light rail system**
  - LRT Ankara
  - LRT Konya
  - LRT Bursa
  - LRT Tunis
  - LRT Valencia
  - LRT Guadalajara
  - LRT Lagos
  - LRT Monterrey
  - LRT Monterrey Ext.
  - LRT Lisbon

- **High speed + interurban**
  - HSL Madrid-Sevilla
  - HSL Lisbon
  - HSL Zuid
  - HSL Cologne-Rhine/Main
  - Main Line Stendal-Uelzen
  - Cargo Hamburg
  - Main Line Magdeburg-Marienborn
  - Airport Link Cologne-Bonn
  - HSL Cologne-Rhine/Main

- **Airport link**
  - Airport Link Kuala Lumpur
  - Airport Link Cologne-Bonn
  - Airport Link Bangkok
  - Airport Link Shanghai

- **Metro**
  - Metro Athens
  - Metro Ankara
  - Metro Buenos Aires
  - Metro Shanghai
  - Metro Guangzhou
  - Metro Kaohsiung
  - Metro Bangkok
  - Metro Shanghai
  - Metro Uijeongbu

- **Val**
  - Val Toulouse
  - Val Charles de Gaulle/Paris
  - Val Orly/Paris
  - Val Edinburgh
  - Val Rennes
  - Val Lille
  - Val Lisbon

- **Skytrain**
  - Skytrain Bangkok
  - Skytrain Shanghai

- **Val**
  - Val Chicago
  - Val Monterrey
  - Val Monterrey Ext.

- **Metro**
  - Metro Athens
  - Metro Ankara
  - Metro Buenos Aires
  - Metro Shanghai
  - Metro Guangzhou
  - Metro Kaohsiung
  - Metro Bangkok
  - Metro Shanghai
  - Metro Uijeongbu

- **Airport link**
  - Airport Link Kuala Lumpur
  - Airport Link Shanghai
  - Airport Link Bangkok

- **Val**
  - Val Chicago

- **Airport link**
  - Airport Link Kuala Lumpur
  - Airport Link Shanghai
  - Airport Link Bangkok
Qatar Education City People Mover System
Project overview

<table>
<thead>
<tr>
<th></th>
<th>Customer</th>
<th>Qatar Foundation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contract awarded</strong></td>
<td></td>
<td>May 16, 2012</td>
</tr>
<tr>
<td><strong>Route length</strong></td>
<td></td>
<td>Approx. 12 km</td>
</tr>
<tr>
<td><strong>Number of stations/stops</strong></td>
<td></td>
<td>4 + 20</td>
</tr>
<tr>
<td><strong>Vehicles</strong></td>
<td></td>
<td>19 Avenio trams with HES energy storage</td>
</tr>
<tr>
<td><strong>Operation mode</strong></td>
<td></td>
<td>On-sight operation</td>
</tr>
<tr>
<td><strong>Planned completion: North Campus</strong></td>
<td></td>
<td>June 2016</td>
</tr>
<tr>
<td><strong>Planned completion: South Campus</strong></td>
<td></td>
<td>December 2016</td>
</tr>
</tbody>
</table>

North Campus

South Campus
"Through the desert without catenaries"
Special features of this project

First rail project in Qatar

High standards of design and architecture:
QEC is an expression of the future vision of Qatar

Catenary free operation between stations / stops

Use of a new type of hybrid energy storage system (HES)

High climatic requirements
• Daily temperatures over 50°C
• High humidity
• High dust load
• Occasional heavy rain

High safety requirements

Siemens will handle operation and maintenance for 3 years
Qatar Education City People Mover System
Project status (1)

Rail construction
2,5 km of rail already laid, rail construction of the North Campus should be completed by Dec 15, the South Campus by Jan 16

Depot
Construction of the depot, workshops and substation is well underway. The first Avenio is scheduled to arrive here in June

Stations / stops
Construction of the foundation with high requirements due to the unusual design of the stations, construction of the plant rooms (low set)

Power supply
Power cabling has started, transformers delivered, switchgear will be delivered shortly

Signaling system
Production of signaling components
Qatar Education City People Mover System

Project status (2)

The first Avenio is currently being tested at the Test and Validation Center in Wildenrath. The remaining 18 vehicles will be completed by February 16. In June 2015 the first vehicle will arrive in Doha.

First installations at the construction site. Completion of the control center concept, delivery of components.

Final inspection of the facilities and preparation of the first deliveries. Interfaces to be clarified with the installation of heavy machinery (underfloor wheel lathe, washing system, cranes, underfloor lifting system).

Completion of traffic light control units. Coordination of final tram routes with the customer.

Detailing of operation and maintenance concepts. Recruitment of personnel on location site. Preparation of training for operating and maintenance personnel.
Qatar Education City People Mover System – the Avenio Tram
Our trams
The result of more than 130 years of experience

Berlin 1881: World's first tram
- Single car
- No overhead line

1992 – 2000 GT trams
- Single-articulation vehicle
- More than 500 units (for Munich, Nuremberg, Frankfurt/M, other cities)

1996 – 2010 Combino
- Multi-articulation vehicle
- More than 550 units (for Bern, Amsterdam, Melbourne, other cities)

2005 – 2009 Combino Plus
- Single-articulation vehicle
- 64 units (Lisbon, Budapest)

Today Avenio / Avenio M
- Single- or multi-articulation vehicle
- Optimal synthesis of experience and innovation

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Page 12
April 2015
Mobility Division
Avenio
Maximum benefits for operators, passengers and the environment

The synthesis of experience and innovation
Made for every infrastructure and every tram system
Made for every need and for more passengers
Made for your cityscape and your budget

Proven and reliable from the first day on
Light, quiet and comfortable
The ultimate in passenger capacity
Design meets lifelong economical operation
## Avenio

A modular configuration kit for individual customer needs

### Vehicle lengths

<table>
<thead>
<tr>
<th>Length</th>
<th>Number of passengers for different vehicle widths¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 m</td>
<td>2.30 m: 35 + 69 = 104, 24 + 79 = 103</td>
</tr>
<tr>
<td></td>
<td>2.30 m: 36 + 73 = 109, 36 + 86 = 122, MD</td>
</tr>
<tr>
<td>27 m</td>
<td>2.30 m: 46 + 79 = 105, 46 + 76 = 122, MD</td>
</tr>
<tr>
<td>36 m</td>
<td>2.30 m: 36 + 73 = 109, 36 + 86 = 122, MD</td>
</tr>
<tr>
<td>45 m</td>
<td>2.30 m: 46 + 79 = 105, 46 + 76 = 122, MD</td>
</tr>
<tr>
<td>54 m</td>
<td>2.30 m: 35 + 69 = 104, 24 + 79 = 103</td>
</tr>
<tr>
<td>63 m</td>
<td>2.30 m: 36 + 73 = 109, 36 + 86 = 122, MD</td>
</tr>
<tr>
<td>72 m</td>
<td>2.30 m: 35 + 69 = 104, 24 + 79 = 103</td>
</tr>
</tbody>
</table>

1) Number of seats + Standing room 4 persons per m²

MD = Mono-directional vehicle; BD = Bi-directional vehicle

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Avenio
Doha Education City (Qatar)

<table>
<thead>
<tr>
<th>Number of vehicles</th>
<th>19 vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of delivery</td>
<td>2015 - 2016</td>
</tr>
<tr>
<td>Configuration</td>
<td>3 cars (bi-directional operation)</td>
</tr>
<tr>
<td>Wheel arrangement</td>
<td>Bo' 2' Bo'</td>
</tr>
<tr>
<td>Vehicle length</td>
<td>27,700 mm (over coupling)</td>
</tr>
<tr>
<td>Vehicle width</td>
<td>2,550 mm</td>
</tr>
<tr>
<td>Gauge</td>
<td>1,435 mm</td>
</tr>
<tr>
<td>Capacity (4 P/m²)</td>
<td>165 incl. 56 seats/3 tip-up seats</td>
</tr>
<tr>
<td>Floor height</td>
<td>350/435 mm</td>
</tr>
<tr>
<td>Special features</td>
<td>Adaptation to climatic conditions; Vehicle for fully catenary-free operation (hybrid-storage UltraCaps + Battery); WiFi and Infotainment</td>
</tr>
</tbody>
</table>
Avenio
Doha Education City (Qatar) interior and testing

**Design philosophy:** "From the shade came the light"

**Validation Test**
in Vienna Climate Wind Tunnel (RTA)
Qatar Education City People Mover System – Catenary Free Operation
Siemens Catenary Free Solution
Hybrid Energy Storage System

Capacitors
Capacitor units ensure highest performance and short charging times

High performance batteries
Batteries provide highest energy capacity for unexpected stops and longer sections without catenary
Siemens Catenary Free Solution
Applications of the Hybrid Energy Storage System

Catenary free operation

<150 m

Catenary free operation

150 m < Distance < 2,000 m

Distance between stations <600 m

Charging

DLC + Battery

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Siemens Catenary Free Solution
How the Hybrid Energy Storage System works

V

Accelerate  Cruise  Brake  Dwell

DLC  Battery  DLC  Battery  DLC  Battery  DLC  Battery
Charging process at the stations – challenges and realization:

• Application of rigid conductor rails in stations and stops only
• Avoiding of arcing during the charging process
• Use as much energy as possible during the dwell time
• Automatic energy flow control / optimization of by operation prediction
• No "intelligence" in charging stations – vehicle controls the charging by itself
Siemens Catenary Free Solution
Technical implementation in Education City

- Traction and storage inverter
- Re-cooling module
- DLC roof container
- Li-Ion battery incl. cooling unit
- DLC seat container
Siemens Catenary Free Solution
Charging infrastructure

- Decentralized, conventional rectifier substations along the line generate power in a defined quality
- Centralized local charging units in each stop distribute the charging power and protect all equipment for a safe charging process
# Siemens Catenary Free Solution

Benefits of an energy storage solution

<table>
<thead>
<tr>
<th>Safety</th>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Enhanced safety, no danger by magnetic fields and touch voltages</td>
<td>• Up to 25% energy savings</td>
</tr>
<tr>
<td>• No impact on road construction and maintenance</td>
<td>• Up to 25% lower CO\textsubscript{2} emissions</td>
</tr>
<tr>
<td>• No influence by sand, water, flooding …</td>
<td>• No additional weight &gt; compensated through light and optimized vehicle construction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Low operation costs</td>
<td>• Participation in world future technology</td>
</tr>
<tr>
<td>• Maintenance free technology / no complex switching technology</td>
<td>• Open systems, no dependency on one supplier</td>
</tr>
<tr>
<td>• Easy to extend and upgrade</td>
<td></td>
</tr>
</tbody>
</table>
Thank you for your attention

Siemens Press Conference, PCW Wildenrath, 2015-04-21