Panel Discussion:
“Compact, livable and safe cities are also more resilient”

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Let us explore what Redundancy and Flexibility imply when applied to Urban Networks: Transport and Electricity distribution

*Resilient cities* demonstrate *seven qualities* that allow them to withstand, respond to, and adapt more readily to shocks and stresses

1. Reflective: using past experience to inform future decisions
2. Resourceful: recognizing alternative ways to use resources
3. Robust: well-conceived, constructed, and managed
4. **Redundant**: spare capacity purposively created to systems accommodate disruption
5. **Flexible**: willingness and ability to adopt alternative strategies in response to changing circumstances
6. Inclusive: prioritize broad consultation to create a sense of shared ownership in decision making
7. Integrated: bring together a range of distinct systems and institutions
Obviously a combination of several urban transport modes are likely to provide Redundancy and Flexibility.

<table>
<thead>
<tr>
<th>Individual transport</th>
<th>Shared individual transport</th>
<th>Collective transport transit</th>
</tr>
</thead>
<tbody>
<tr>
<td>area served:</td>
<td>Entire road network</td>
<td>Entire road network</td>
</tr>
<tr>
<td>Schedule:</td>
<td>On demand</td>
<td>On demand</td>
</tr>
<tr>
<td>From where to where:</td>
<td>Door to door</td>
<td>Door to door</td>
</tr>
</tbody>
</table>

- **Walk**
- **Bicycle**
- **Electric scooter**
- **Motorcycle**
- **Car drive alone**

- **Taxi**
- **Carpool**
- **Uber, Lyft**
- **Uber pool**
- **self driving car**
- **I-Road Toyota at stations**

- **Bus**
- **Light rail, tram**
- **Collective taxi**
- **Bus Rapid Transit (BRT)**
- **Subway**
- **Suburban rail**

Among modes of transport, a balance between Shared Individual Transport and Collective Transport are able to maximize Redundancy and Flexibility.
Experimental Transport system combining transit with shared individual vehicles as operating in Grenoble
If shared individual transport modes and buses are the most resilient urban transport systems then medium density cities are the most transport resilient.
A combination of grid and in individual solar generation could provide Redundancy and Flexibility in electricity generation

• Most zero net energy buildings get half or more of their energy from the grid, and return the same amount at other times.

• Buildings that produce a surplus of energy over the year may be called “energy-plus buildings” these could be used to provide electricity to electric vehicles

• A roof of 200 m² covered with solar panel would provide about 120 KwH of electricity assuming an average of 5 h of sunlight a day, enough for a family of 4 and for 2 Toyota i-road personal mobility vehicles

Row houses producing about 120 kwh per day. This would be enough to power electric vehicles.

This type of row-houses would correspond to a residential density of about 80 people/ha.

The density would have to be lower in regions with low solar intensity and higher in regions with high solar intensity.
However, densities driven entirely by photovoltaic electricity generation would result in an absurd distribution of urban population! As urban densities will have to be much higher in the South West of the US than in the North East!
Cities are complex organizations that cannot be shaped only by abstract concepts like resilience or compactness.

However, in developing infrastructure components like transport or energy distribution, it is legitimate to apply resilience constraints.

Resilience is a constraint to be taken into account in development, it cannot be an objective.