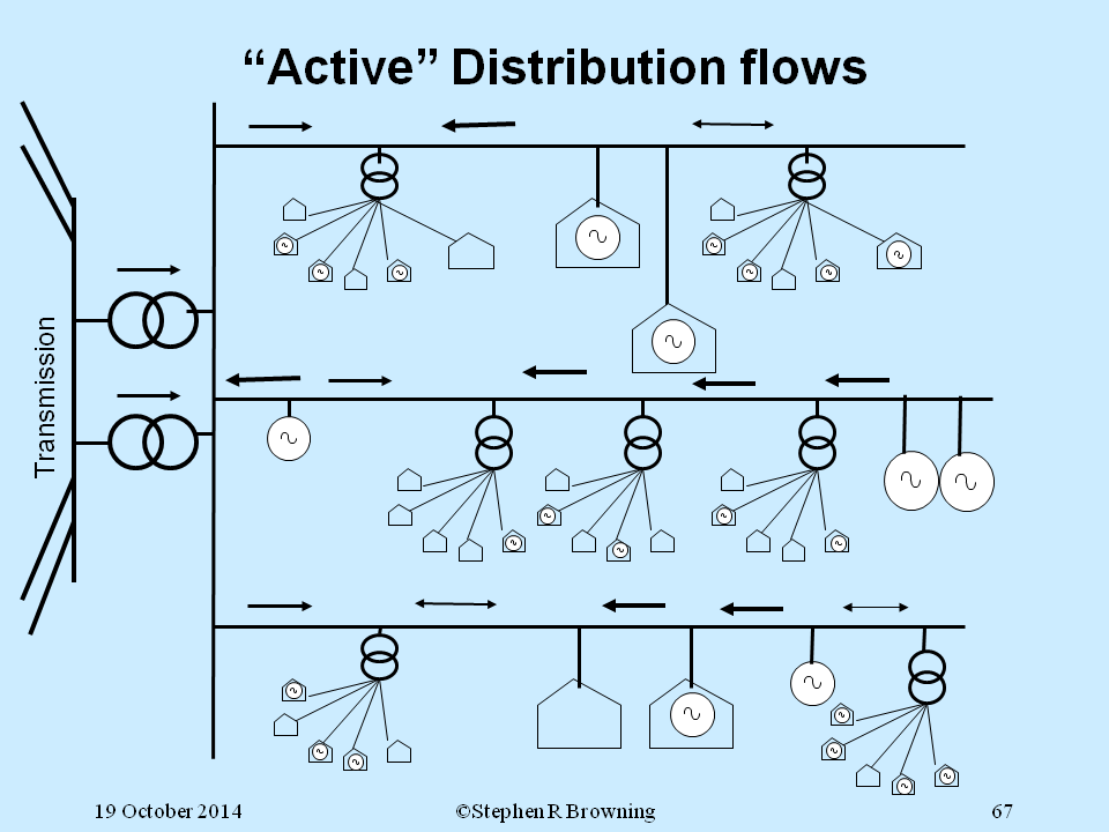
Although the overall distribution energy supplied at a grid supply point will decrease with distributed generation, the supply point and the individual feeders will experience variable power flow patterns depending on the amount, type and distribution and location of generation connected.

Renewable generation output will of course vary depending on weather (irradiance, wind speed,) while CHP and CCHP will run at a constant output depending on the heat requirement.

The result will be variations in flow patterns by weather, time of day, day of the week and time of the year, all of which will be hard to predict. Such variations will need to be managed to avoid voltage and stability excursions on the distribution system.



Customers are also actively trying to reduce their energy demand. In addition, Non-time-critical demand is being identified and proposed for use as a short term reserve.

In modern low energy and passive housing, the residual electrical demand will be cooking, lighting and entertainment plus the small ventilation system and heating load; demand will probably peak during darkness. At this level, premises CHP is inappropriate (low heating load), although communal heating/cooling CHP may be

appropriate. Distributed generation for such premises will probably comprise PV or Microwind.

As regards Power Quality, more modern devices such as compact fluorescent lights and switched mode power supplies in electronic and entertainment equipment are introducing increased levels of harmonic 'pollution' at distribution level. The demand in low energy houses will comprise a higher percentage of such devices. DC-AC micro-generation inverters also introduce harmonic distortion into the supply.

Customers need to be made more aware of the impact of their demand and embedded generation at different times. Instantaneous delivery of electrical power matched to demand, not just energy over time, has to be securely managed to avoid interruption, overloading of circuits, voltage excursions and inefficient and unnecessary running of a main fossil fired plant. The resulting need for accurate and separate forecasting of generation and demand at this level needs to be made clear.

So, to maintain a secure active distribution network with its changing flow patterns, it is necessary to monitor embedded generation, demand and remote line flows and voltage levels to a greater extent than with a pure passive system. Levels of control also need to be exercised to maintain delivery and quality within prescribed limits. The correct level of control can also reduce peak flows and thus allow more efficient Network design without unnecessary excess capacity. This in turn leads to a cheaper but weaker and thus more volatile network, where both generation and demand need careful control and active power quality conditioning may need to be applied. The use of storage to buffer fluctuations may also be beneficial as an alternative to more capacity.

This leads to the conclusion that all 'Distributed Electricity Resources' (DER) on an active system, generation, demand and storage must be monitored and the appropriate level of control by 'trading' applied to ensure secure operation. The operator of the passive distribution network has to become more active - a distribution system operator.