New Elevator Technologies

To Generate, save, and store electricity

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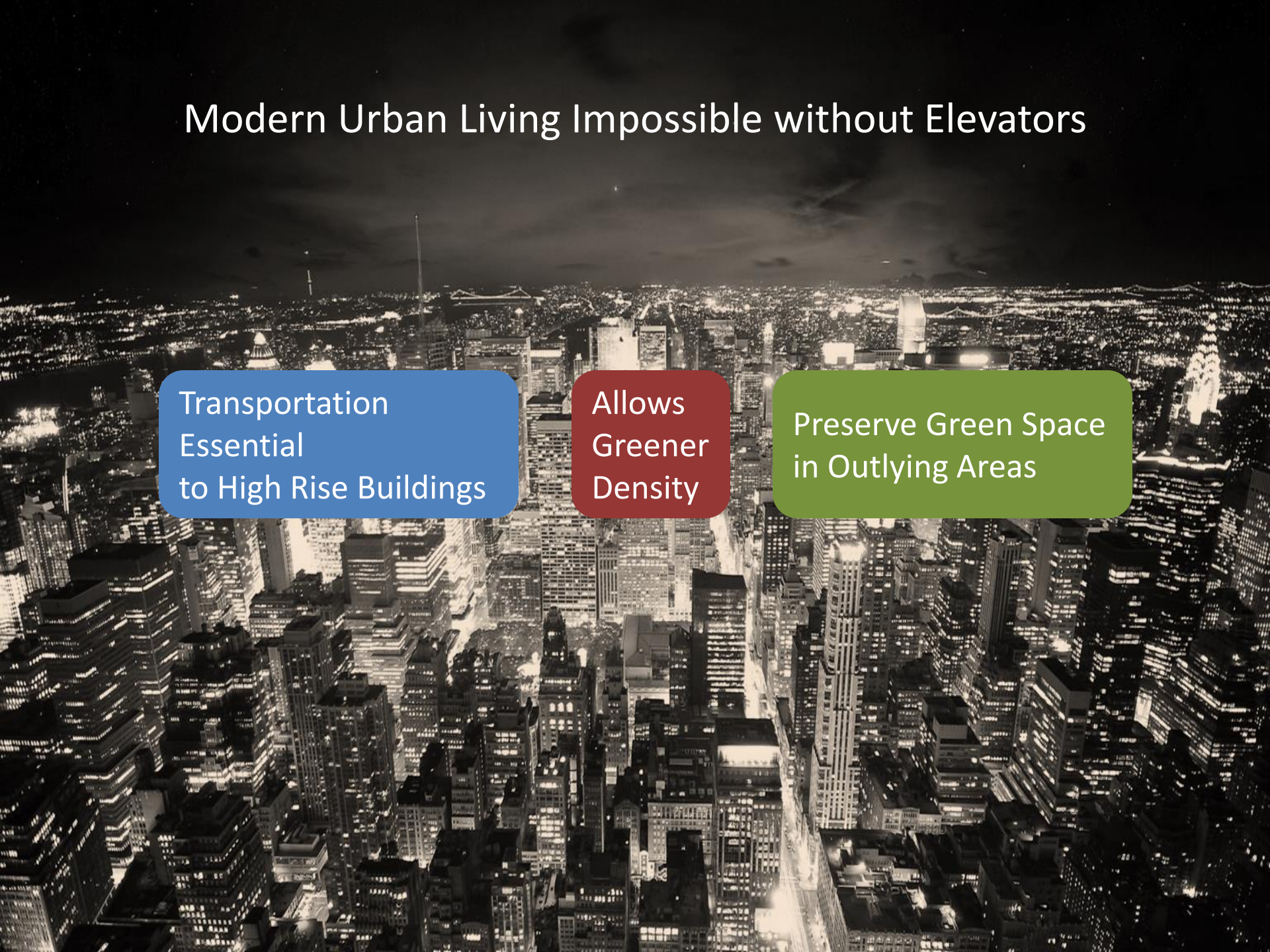
Energy Investment Systems

Energy Investment Systems Inc.

- Develops Energy Efficiency Programs for Multifamily building
- Facilitates Implementation strategies
- Introduces new concepts and technologies
- Implements and administers submetering systems
- Conducts policy analysis for Government Agencies

Modern Urban Living Impossible without Elevators



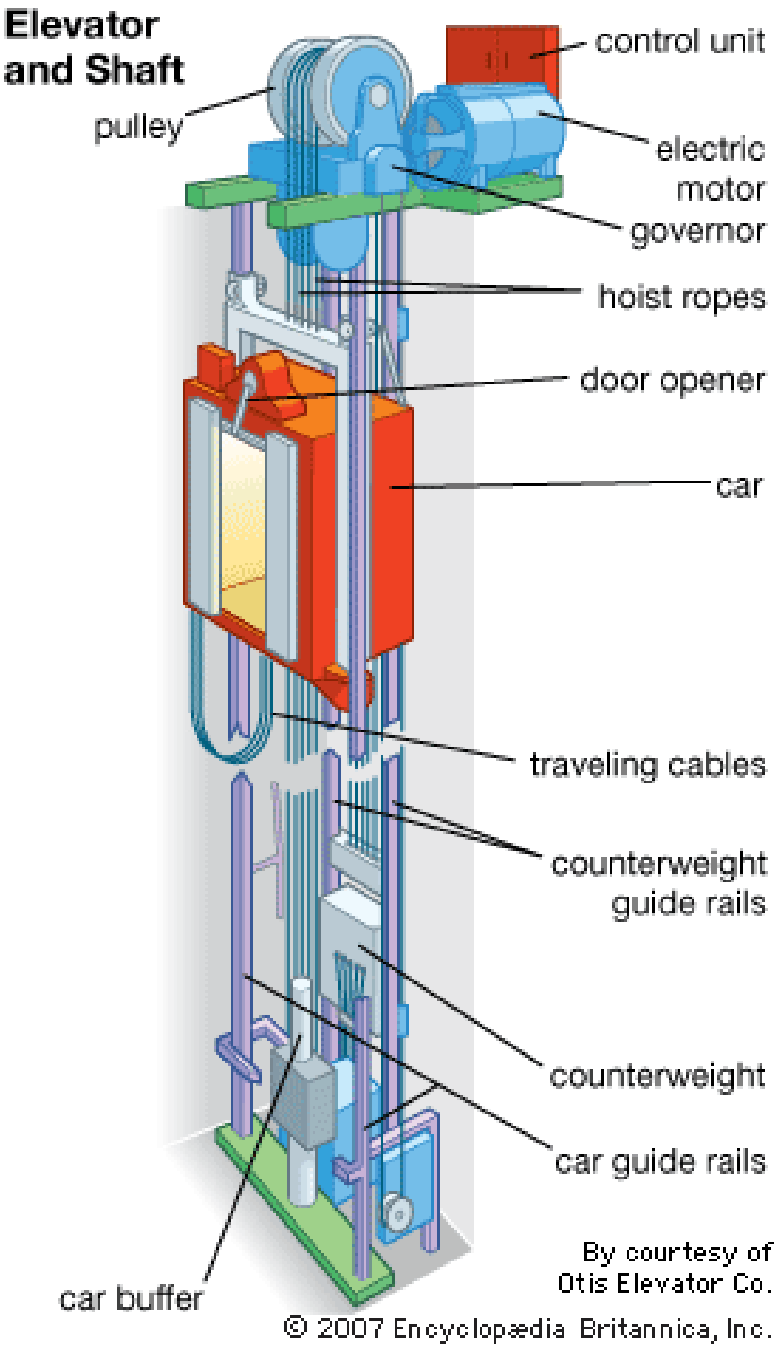
Transportation Essential to High Rise Buildings

Allows Greener Density

Preserve Green Space in Outlying Areas

Creating the *Vertical City*

- Skyscrapers became commonplace thanks to the invention of the safety break for Otis elevators in 1857
- Elevators are the safest and among the most efficient form of transportation
- In New York City, elevators travel more passenger miles vertically than the subway moves people horizontally
- Elevator manufacturers adopt green revolution with vengeance



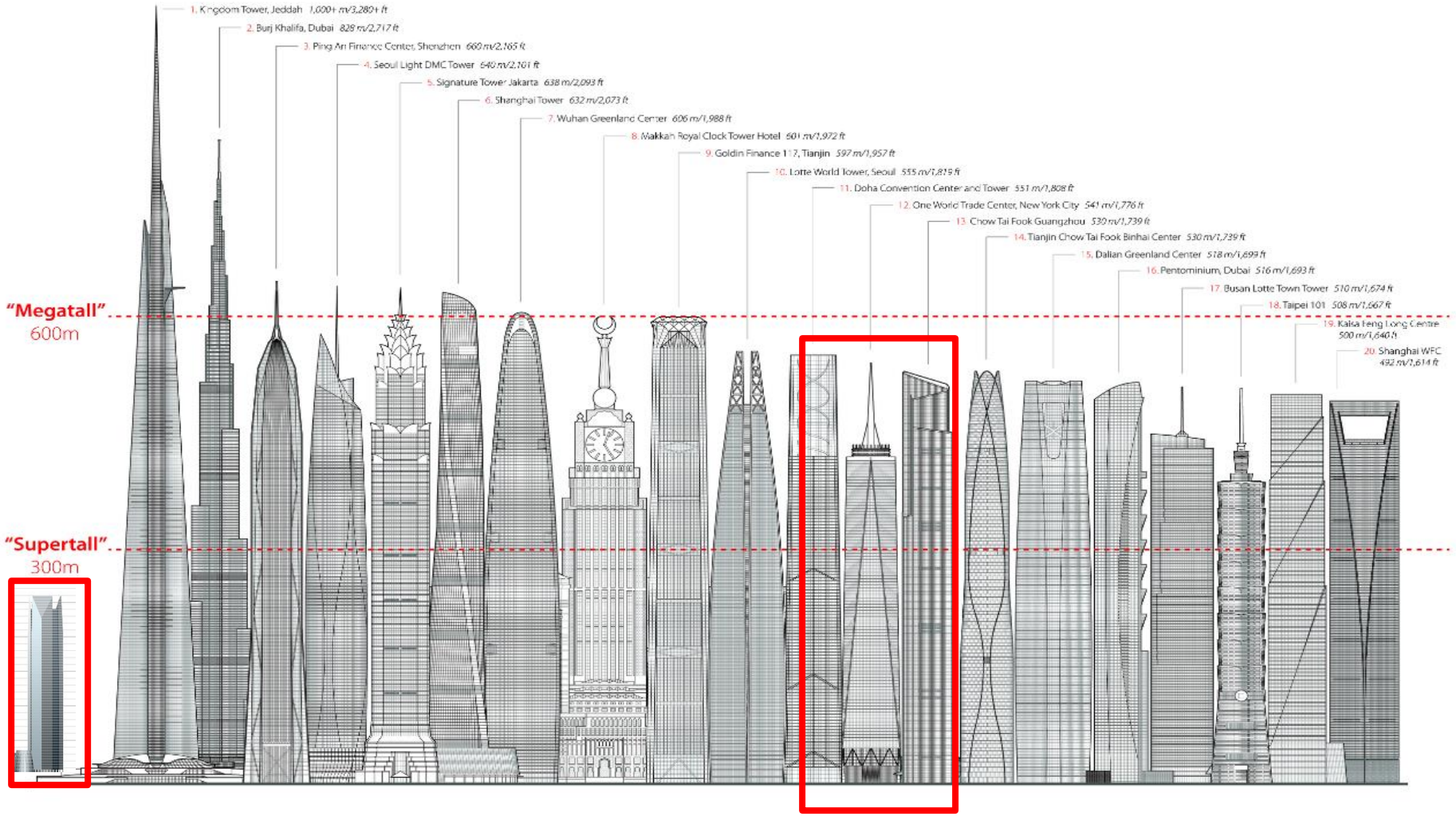
Otis Safety Elevator(brakes) (1853)

- Facilitates High-Rise Construction
- Reversed Real Estate Values
- Enabled High-Rise Activities
- Enabled Increased Density of Cities
- Unleashed Architectural Creativity
- Provided Efficiency

The Typical American City Skyline

Oklahoma City Skyline Population: 591,000

The Sky's the Limit



Devon Tower (Oklahoma City)

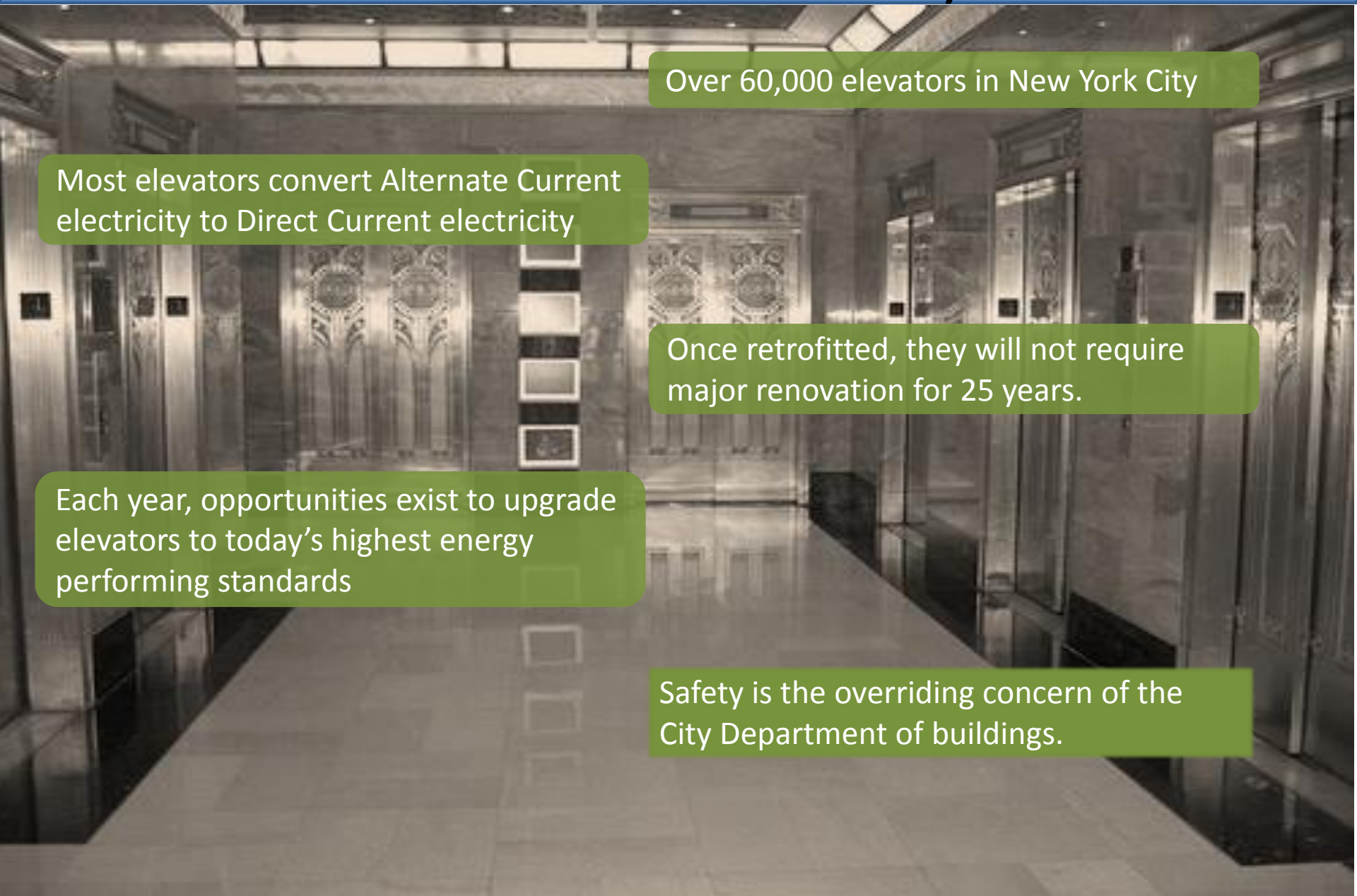
1 World Trade Center (NYC)

Other competitive global cities allow more mega-tall buildings

Elevator Design Priorities

- Assure Safety
- Reduce Wait Times
- Reduce Travel Times
- Assure Smooth/Comfortable Ride
- Reduce Crowding
- Reduce Elevator Space Requirements
- Improve Energy Efficiency
- Permit Taller and Taller Buildings

Elevators in New York City



Over 60,000 elevators in New York City

Most elevators convert Alternate Current electricity to Direct Current electricity

Once retrofitted, they will not require major renovation for 25 years.

Each year, opportunities exist to upgrade elevators to today's highest energy performing standards

Safety is the overriding concern of the City Department of buildings.

Status Quo of Vertical Transport

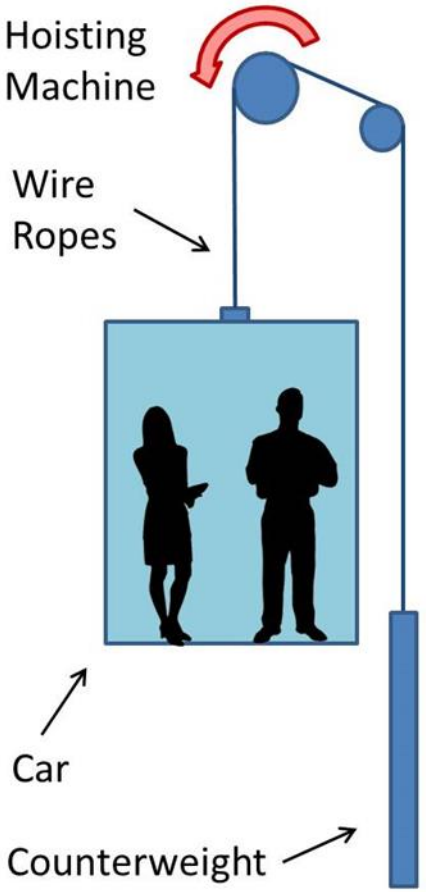
- Most Elevators are Traction Elevators
- Most Existing Elevator Motors are Original (Not Modernized)
- Majority of Motors use DC Electricity (Less Efficient and Require Conversion from Grid Power)
- Many Elevators Have Geared Motors
- Most Elevators Dissipate Electricity as Heat (Requires Grid Power to Cool Control/Engine Room)

Sustainable Elevator Technology

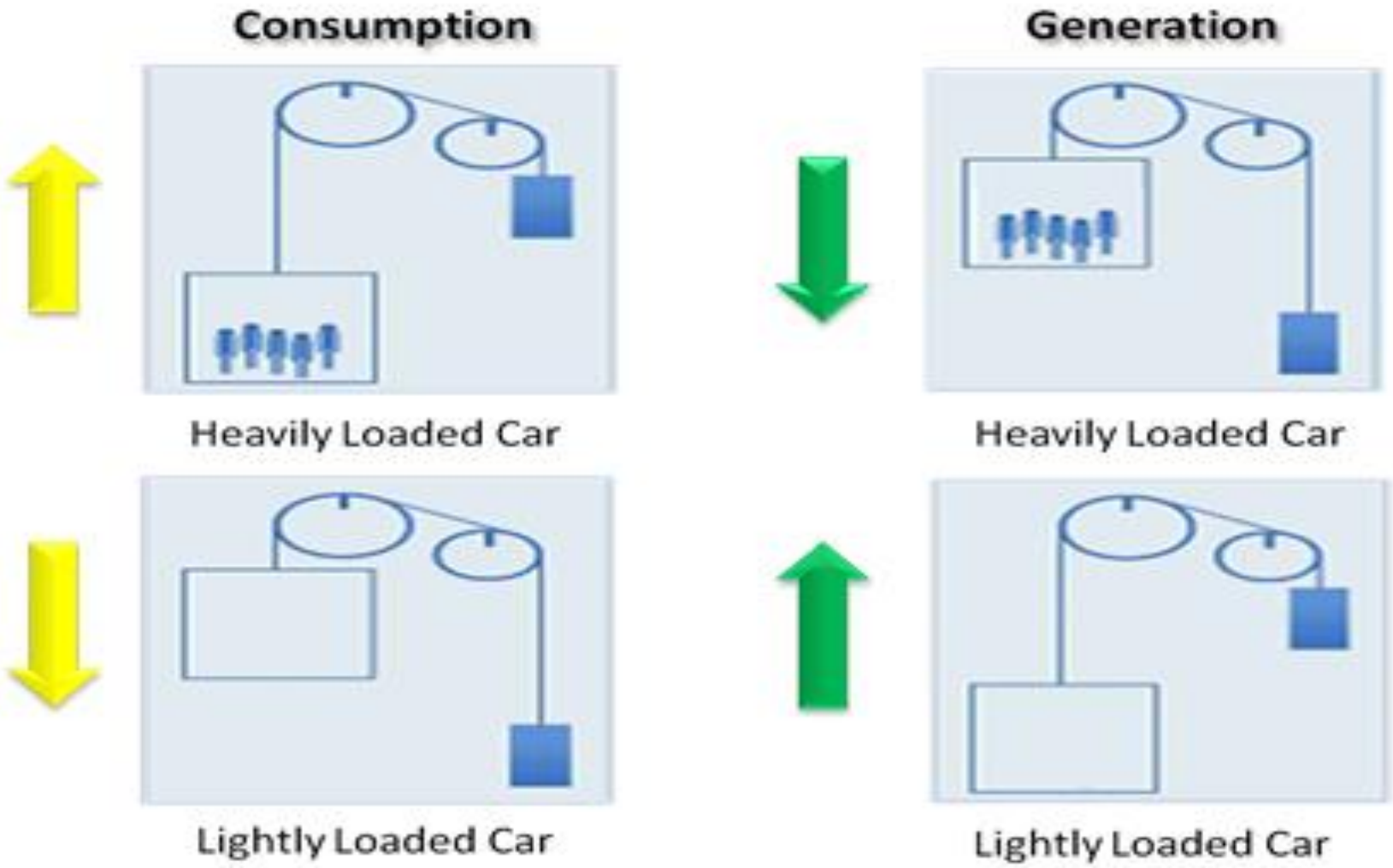
- ent Magnet AC Motors (More Efficient,
- ts to create Magnetic Field Rather Than Grid P
- egenerative Drives
- ky Lobbies
- Double Decker Elevators
- Destination Dispatch
- Machine-Room-Less (MRL) Elevators
- TWIN by ThyssenKrup
- Storage for Emergencies and Peak Shaving (Battery or Kine
  orage Can Be Used)
- Fiber Ropes
- iculator

Traction Elevators

- Operates Like a See Saw (Makes Use of a Counterweight to Make Movement Easier)
- Counterweight 40-50% of Car at Full Load
- Can Be AC or DC, Geared or Gearless
- Extremely Energy Efficient



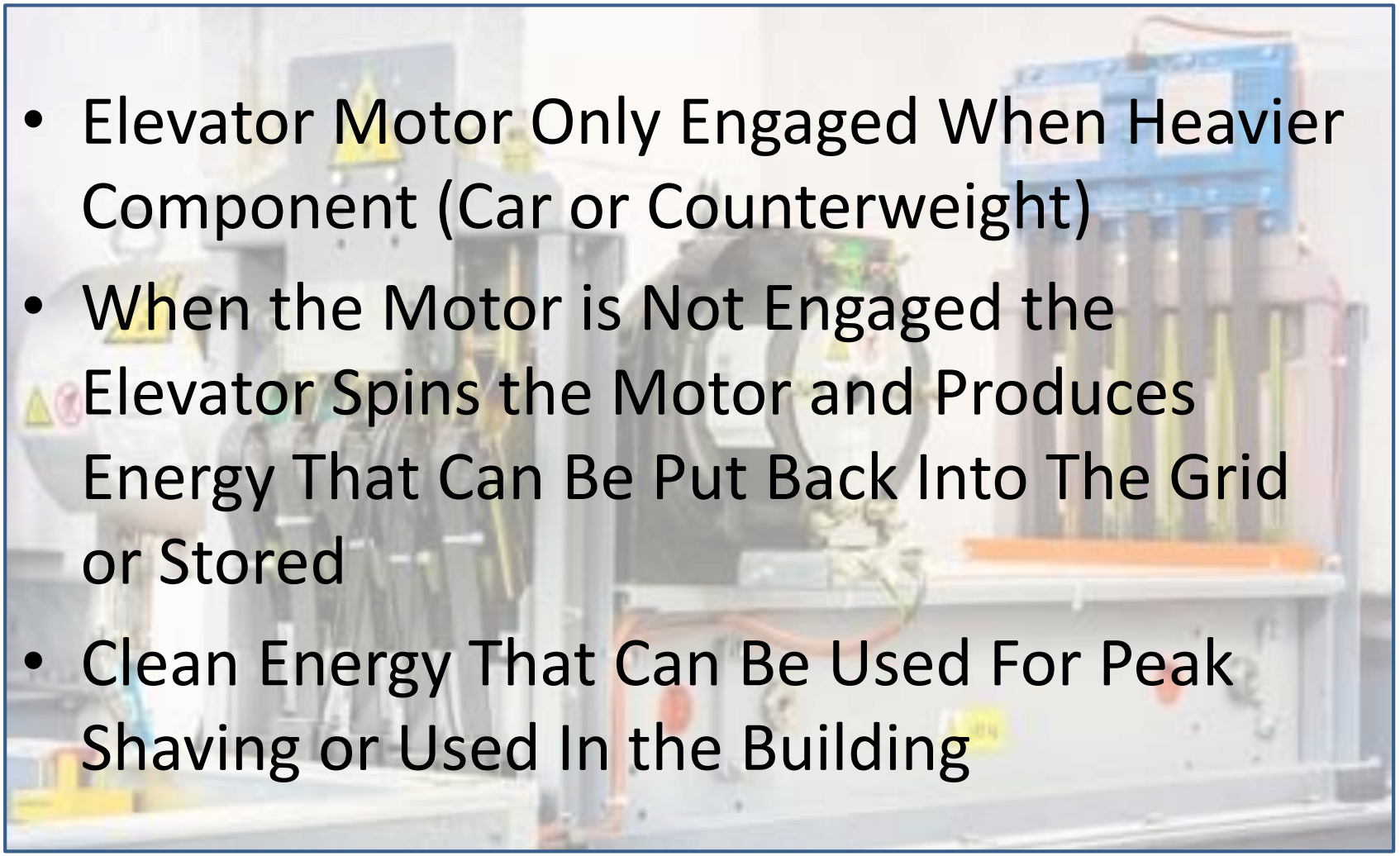
Capturing Gravity



Regenerative Drive Technology

- All Elevators Generate Electricity When Braking
- Second inverter (in reverse orientation)
- Can Generate 20-50% of Electricity Consumed
- Utilizes Gravity as the Power Source

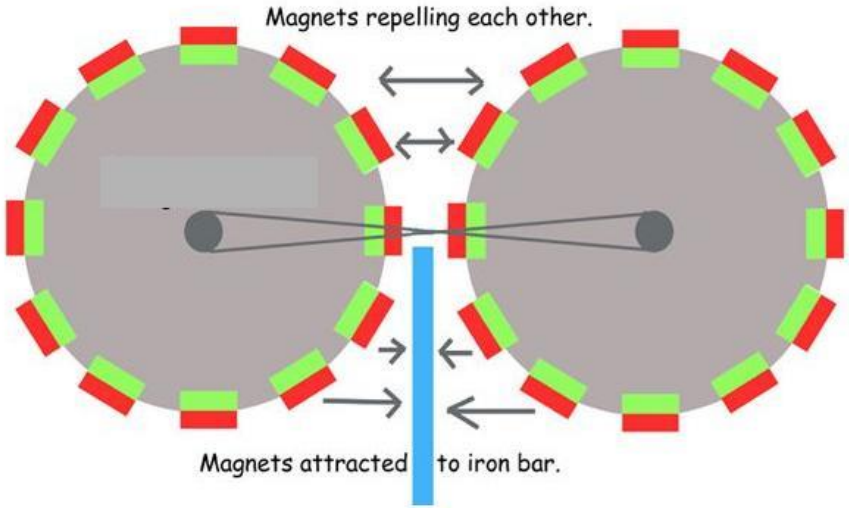
Regeneration Explained



- Elevator Motor Only Engaged When Heavier Component (Car or Counterweight)
- When the Motor is Not Engaged the Elevator Spins the Motor and Produces Energy That Can Be Put Back Into The Grid or Stored
- Clean Energy That Can Be Used For Peak Shaving or Used In the Building

Motors with Permanent Magnets (Rare Earth)

- Motors with Permanent Magnets Produce Limitless Energy via Magnetism
- PMAC Motors more efficient than traditional DC- or AC-powered Motors
- Requires no Gearing
- Reduce Electricity Demand from Grid
- Neodymium Used in Motors of Electric Vehicles and Wind Turbines
- This added efficient means less energy lifting and more energy lifting and more energy regenerated



Savings Can Be Dramatic
Do you Believe in Magic?

A Commonplace Scenario

- Elevator Motor is Geared DC-20 HP
- Motor Gen Set 20 HP
- Elevator Run Time 4 hours/day
- Motor Gen Set Idles 20 hours/day
- 20 HP = 15 KW
- Idles at 1/3 Capacity: 20 hours @ 5 KW = 100 KWH/day
- Full Capacity: 4 hours @ 15 KW = 60 KWH/day
- Total Usage: 160 KWH/day @ $0.20 = $32/day

Savings That Blow Your Mind

- Permanent magnet AC (PMAC) motor eliminates motor gen set saving 100KWH
- PMAC sized at 25% lower capacity: 15 HP or 11.75KW
- Operation for 4 hours @ 11.75KW = 45KWH
- Regenerative drive captures 35%, or 15.75 KWH
- Net usage is 45KWH – 15.75KWH = 24.25KWH/day
- Cost of 24.25KWH @ $0.20 = $5.85
- Savings over worst case: 32KWH - $5.85 = $26.16,

***or 81.7% savings*!**

One Bryant Park Case Study

- Performed in the Energy Potential of Regenerative Drives
- Part of the CV Star Research Foundation of the Cooper Union from NYSERDA in 2011

Methodology

- Metered Elevator Consumption and Generation
- Meters Required to be Portable
- Collect Data in 3 Second Intervals
- Inability to Store More Than a Few Days at a Time
- Inability to Send Wireless Signal Out of Elevator Rooms
- Required Frequent Downloading of Data

Findings For One Bryant Park

- Average Generation to Consumption Ratio was around 35%
- Higher Ratios Were Found in Elevator Banks Serving Higher Floors Averaging at 41%
- Higher floors Peaked at 49%at 7:00
- Generation Consumption Ratio Increase From Morning to Evening
- Disparity of Ratio Was Not as Anticipated and is Relatively Consistent

Findings For Empire State Building

- Generation Consumption Ratio Averaged 22 Percent With Average Weekday Consumption Around 130kWh and Average Generation around 30 kWh.
- Weekend Consumption Generation Ratio Was Higher, Around 27 Percent In Elevators That Were Not Dedicated Office Elevators

The Rescue Elevator
Now On The Drawing Board

- Ability to Store Electricity Generated
- Utilization of Flywheel Technology
- Stored Power Used to Power Elevator not Building Electric Infrastructure
- Eliminated Grid Power During Peaks
- Elevator Operates During Power Emergencies

Extrapolating the Findings

- Using City database, we projected potential savings associated with PMAC and Regen on built environment
- If buildings in NYC are modernized using PMAC and Regen, they could create 748 MW of capacity

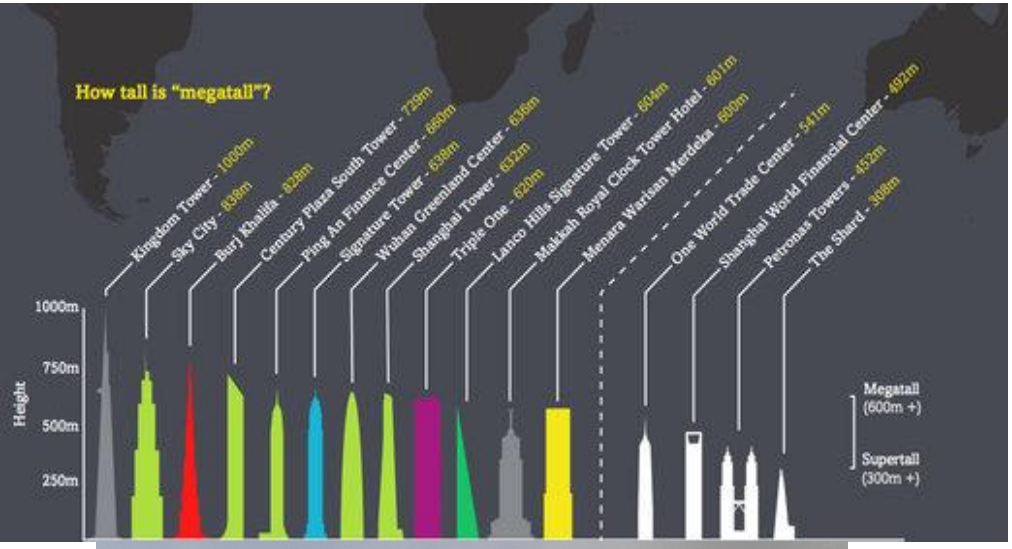
Elevators create effective renewable capacity for New York City

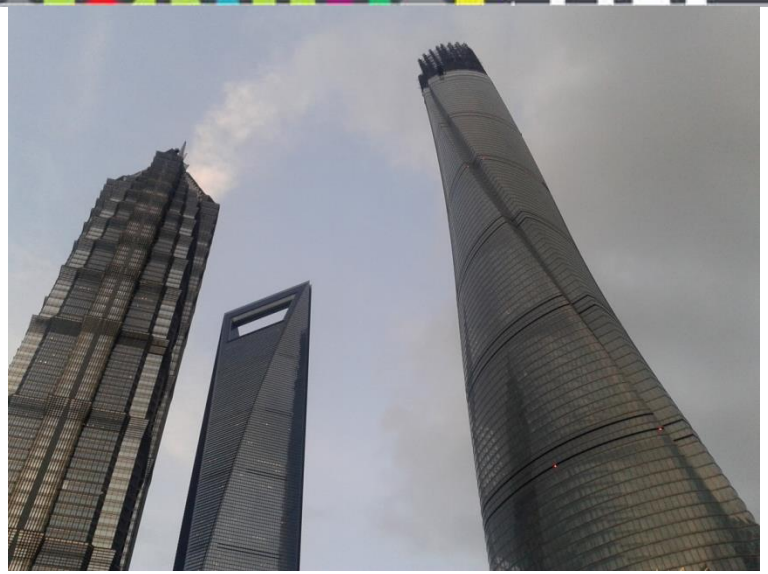
Type of Building	Total Savings (kW)
Residential/Mixed-Use	338,812
Office	354,497
Hospitals	8,311
Hotels	43,827
Education	2,598
Total	**748,045**

Burj Khalifa

- 57 Otis Elevators 2 Double Decker Using MRL
- Speeds Up to 33 ft/s or 22 miles an hour
- 50 Seconds to Go up 1654 Feet a Distance of About 7 City Blocks in Less Than a Minute

Advanced Solutions for Megatall Buildings





- Single Elevator Solutions use PMAC and Regenerative Drives
- Buildings Will Contain Sky Lobbies and Deploy "Express Elevators"
- Express Elevators Could Be Double Deck
- Local Elevators Could Be MRL or Utilize TWIN Technology (Two Cars Per Shaft)
- All Systems Would Deploy Destination Dispatch Technology

What The Future Holds

- Electricity Storage to Shave Peaks and Assist with Emergency Evacuation
- Destination Dispatch Algorithms to Enhance Generation/ Consumption Ratios
- Energy Technology Awareness on Retrofit Applications
- Documented Evidence of Electricity Generation, Storage, and Result Quantification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