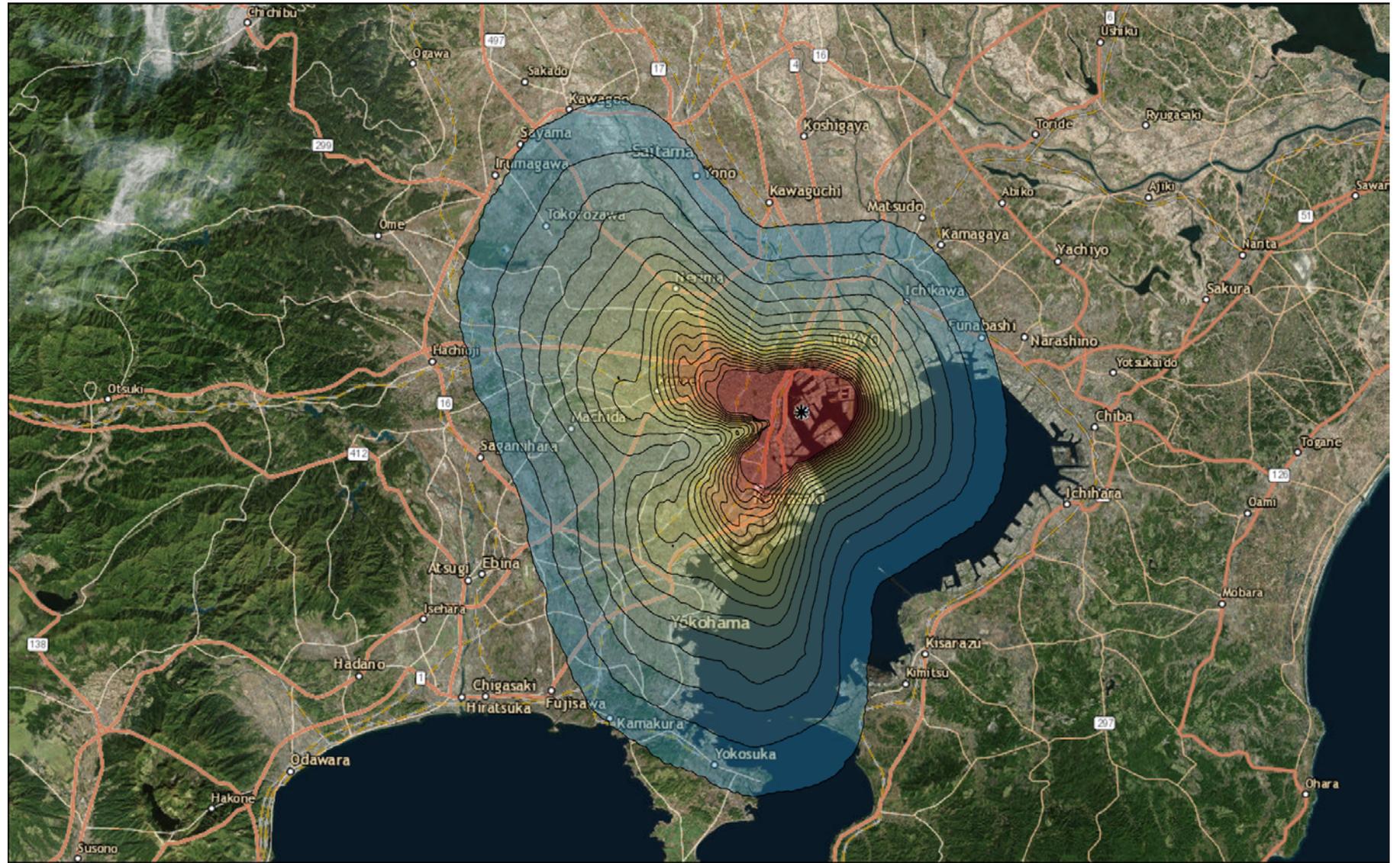
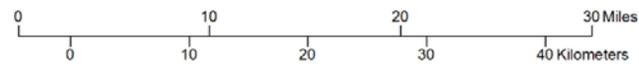
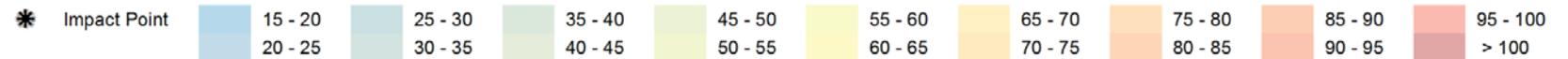


Tokyo peak
air blast
winds due
to Ground
Impact of
90-meter
secondary

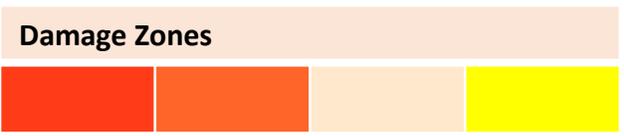
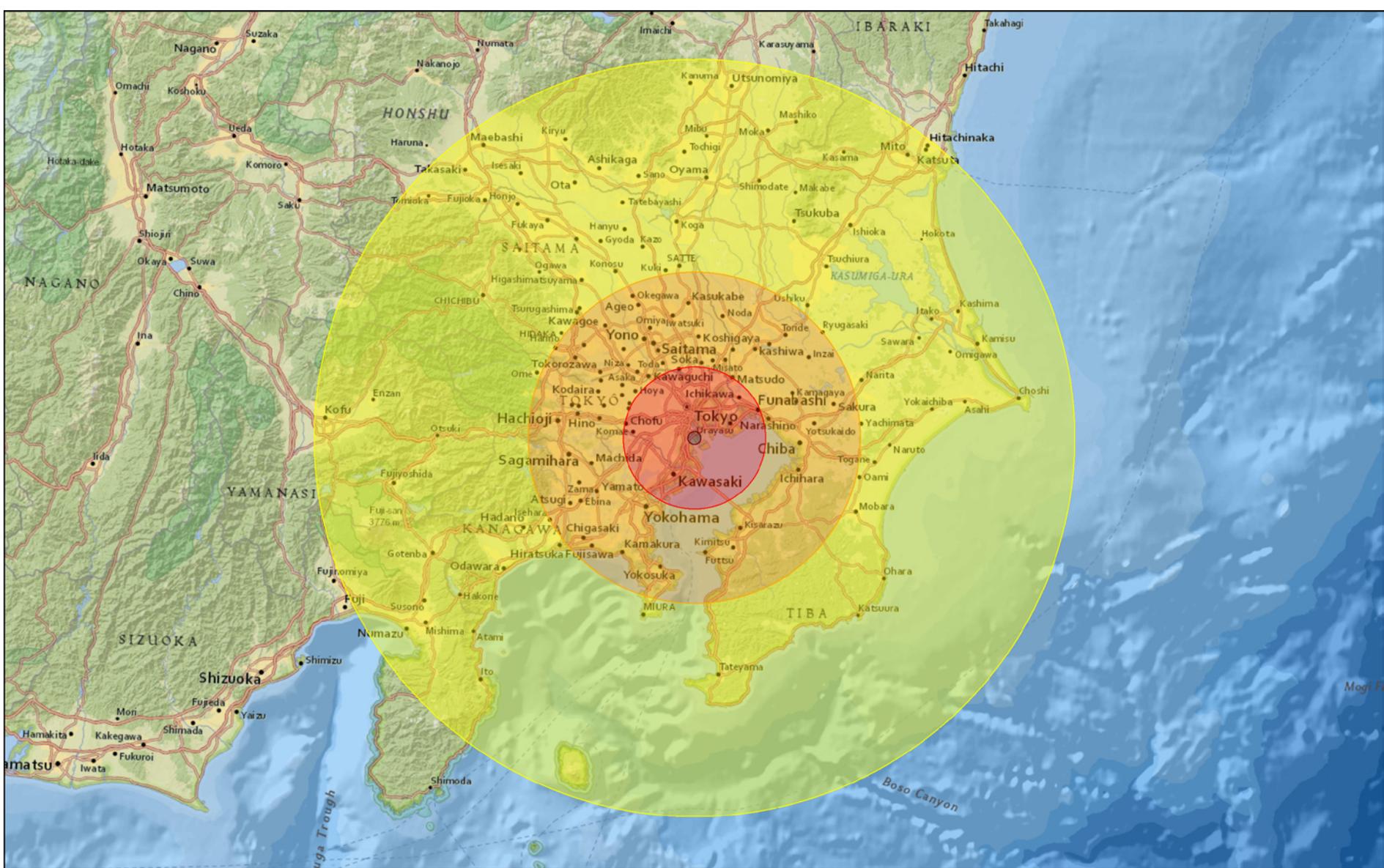


Ground Impact - Winds (m/s) - Tokyo, Japan



Tokyo

Initial crude approximation of Tokyo Impact Damage 270 meter object (Purdue impact simulator)



City	Tokyo	Approx Pres(psi)	Approx. Wind (mph)
Crater radius (km)	3.82		
Truss Bridge Collapse (km)	21	>17.5	>450
Wood Building Collapse (km)	49	>3.8	>128
Windows shatter (km)	112	>0.98	>35



Tokyo Demographics & Industry

- Tokyo-Yokohama worlds largest populous metropolitan area > 37.8M ¹
- Population of prefecture including special wards + 13.7M
- World's largest agglomeration economy; combined population, industry, firms, markets clustered together i
- Heavy industry and manufacturing in Chiba, Kawasaki and Yokohama; light industry in Tokyo proper
- Kawasaki is home to one of the 3 major heavy industrial manufacturers: Kawasaki Heavy Industries (motorcycles, heavy equipment, aerospace and defense, rolling stock and ship, industrial robots, gas turbine and industrial products), Kawasaki Steel and Kawasaki Kisen (Transportation: Marine, Land and Air) ²
- Tokyo is home to a large financial and insurance market³

¹ <https://en.wikipedia.org/wiki/Tokyo>

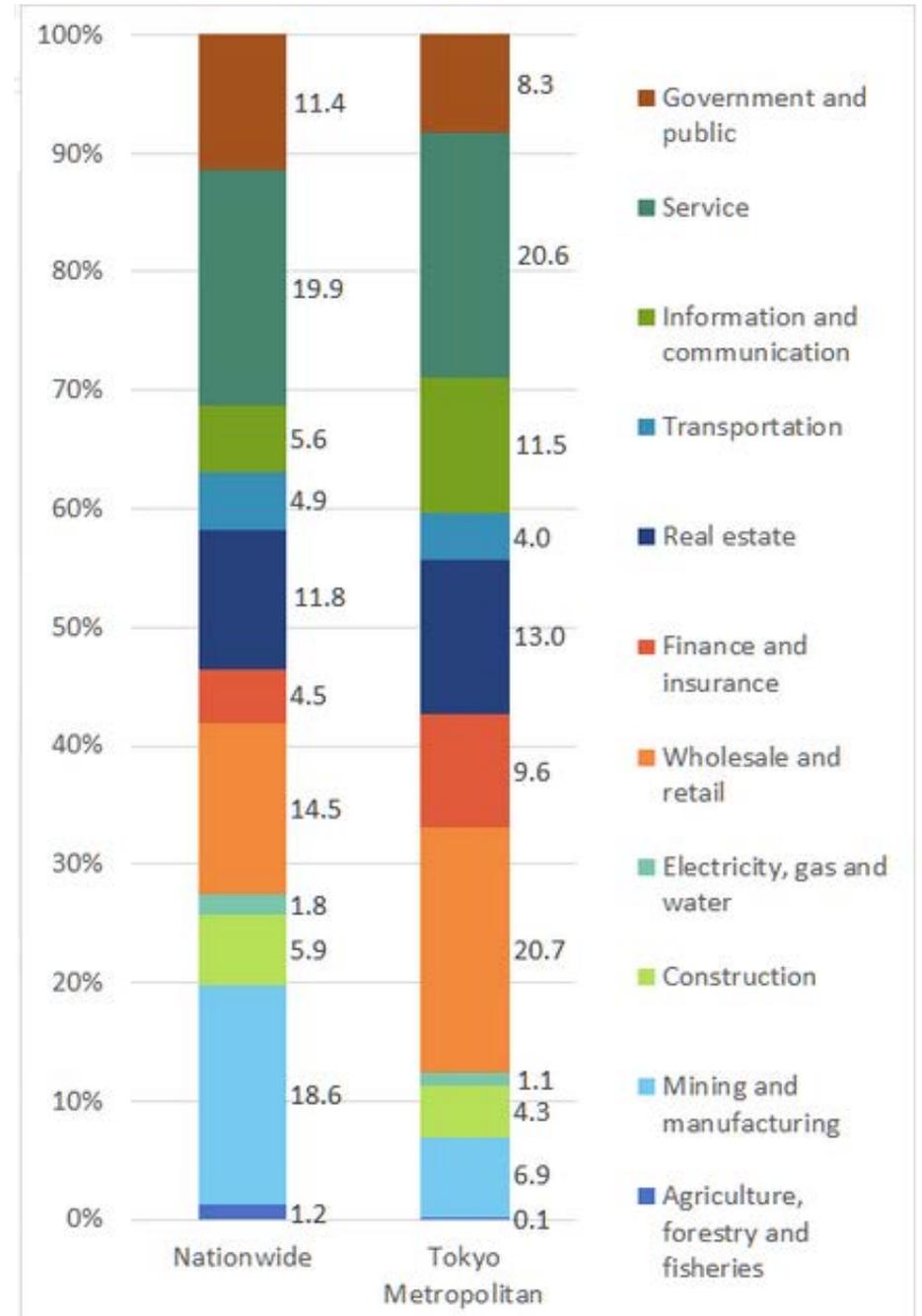
³ <https://www.city-data.com/world-cities/Tokyo-Economy.html>

² https://en.wikipedia.org/wiki/Kawasaki_Heavy_Industries

Tokyo Accounts for 20% of Japan's GDP

- GDP of Tokyo in 2013 was 93.1 trillion yen. Japan GDP was 480 trillion yen in 2013.
- The graph below shows the breakdown of Tokyo GDP and Japan GDP by industry.

http://nbakki.hatenablog.com/entry/Breakdown_of_Tokyo_GDP_2015



Tokyo and Prefecture in 2015, World's 3rd largest Solar/Photovoltaics Installed Capacity

34,150 MW; 3.5% of Nation's Annual electricity

•Solar and Thermal

- Oi Power Station
- Ohgishima Solar Power
- Ukishima Solar Power
- #12

East Tokyo Bay

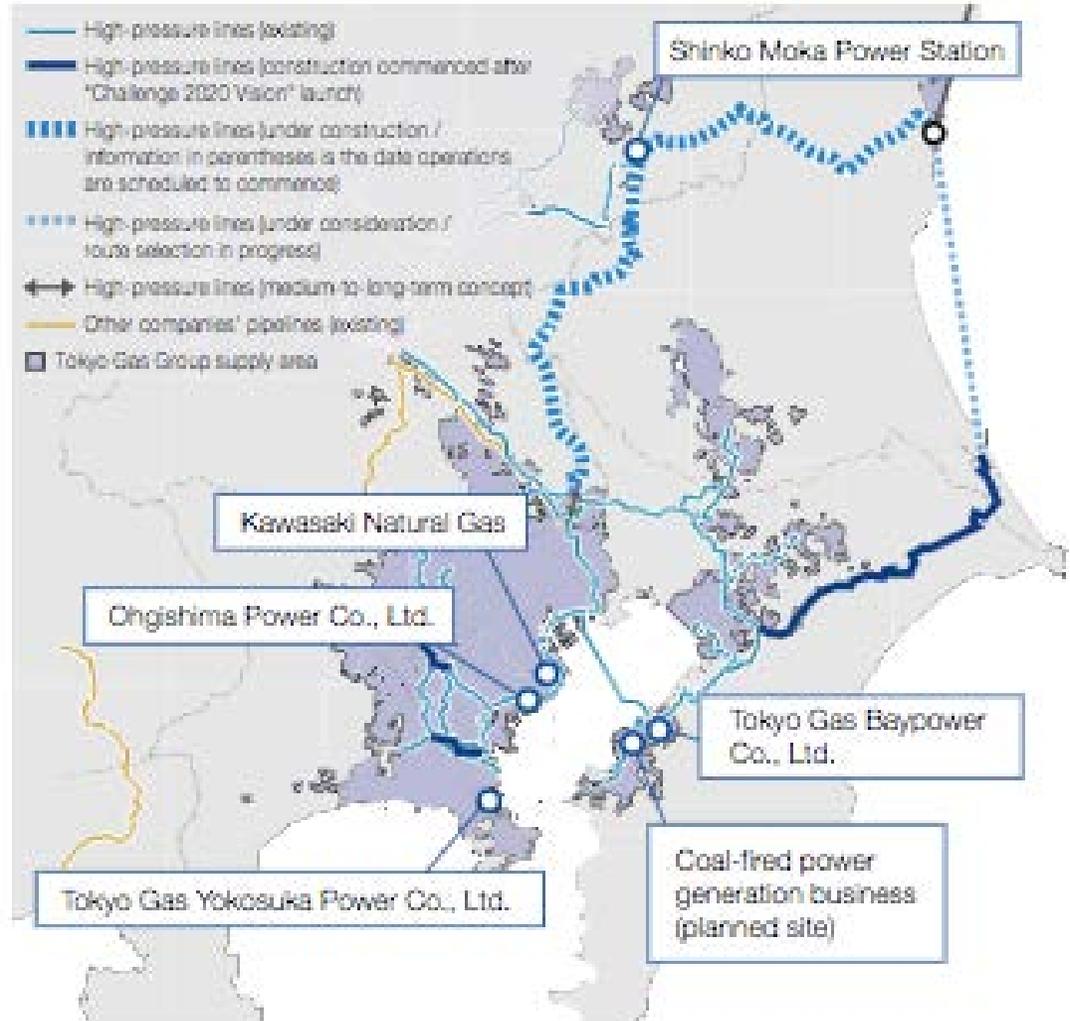
- Anegasaki
- Sodeguara
- Futtsu*

*2nd largest NG [gas-fired](#) power station in the world.
5,040 [MW](#) 4 units, 2 @ 1,520 MW and 1 @ 1,000 MW



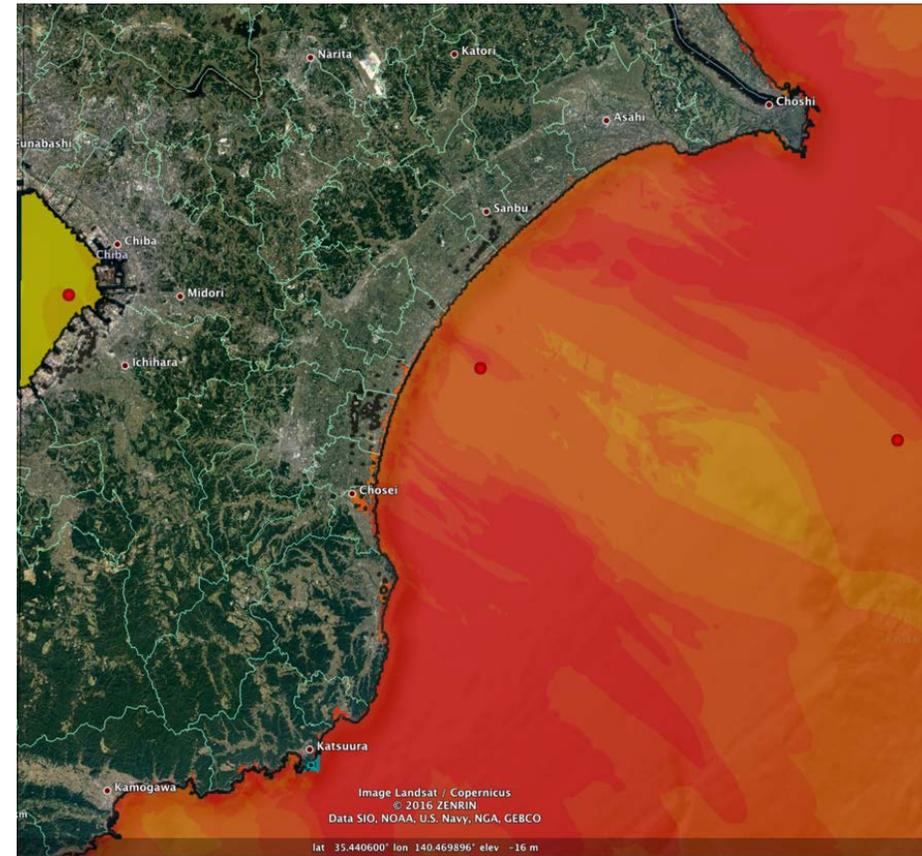
Tokyo Gas-fired Infrastructure

<p>Kawasaki Natural Gas Capacity: 840 MW – 2 Units Tokyo Gas Capacity 400 MW Start of operations 2008 49 % of Tokyo Gas Interest</p>	<p>Ohgishima Power Capacity: 1,221 MW – 3 Stations Tokyo Gas Capacity 900 MW Start of operations 2010 75 % of Tokyo Gas Interest</p>
<p>Tokyo Gas Yokusuka Power Capacity: 240 MW Tokyo Gas Capacity 180 MW Start of operations 2006 75 % of Tokyo Gas Interest</p>	<p>Tokyo Gas Baypower Capacity: 100 MW Tokyo Gas Capacity 100 MW Start of operations 2003 75 % of Tokyo Gas Interest</p>



Simulated Tsunami In Japan Trench – Resulting from Impact of 270-meter primary

- Inundation up to 2 km inland at places
- Fairly uniformly around half a kilometer
- The colors show amplitude of computed waves
- The model computes about 50km² flooded in that area.



Tsunami Risk Mitigation at Fukushima

- The reactor although shuttered; is still seeping contamination
- “Ice wall” implemented to prevent the continued release of radiation
- 1.5 km deep ice wall designed to keep soil frozen
- Any breach would certainly draw further contamination into the ocean

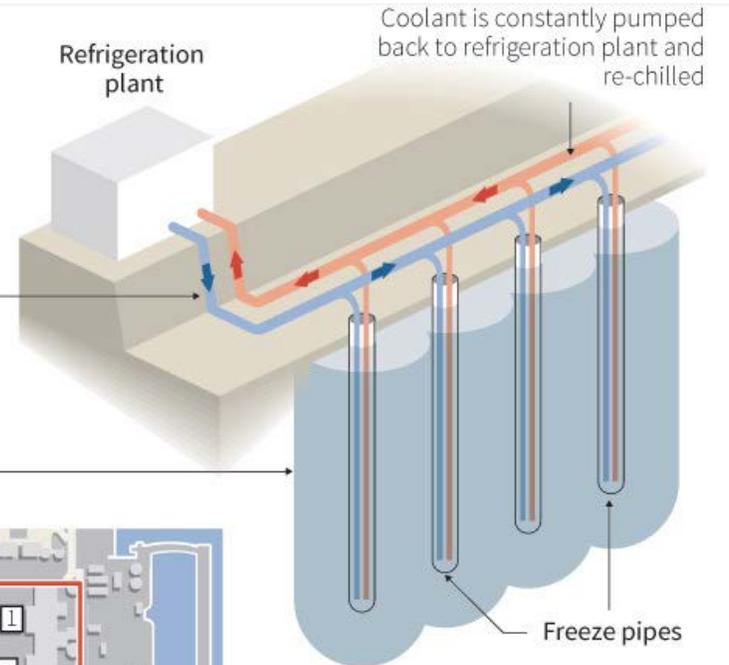
<http://www.pbs.org/newshour/updates/fukushima-radiation-continues-to-leak-into-the-pacific-ocean/>

HOW IT WORKS

A row of shafts are drilled into the ground around the structure's perimeter

Coolant, chilled to below freezing, is pumped into freeze pipes

Groundwater around the pipes freezes, creating a contiguous wall of frozen soil in about six to eight weeks



- Nuclear reactors
- Planned underground barrier will contain contaminated water within the facility while preventing groundwater from flowing into it

Sources: Tepco; Moretrench

F. Chan; staff, 07/08/2013

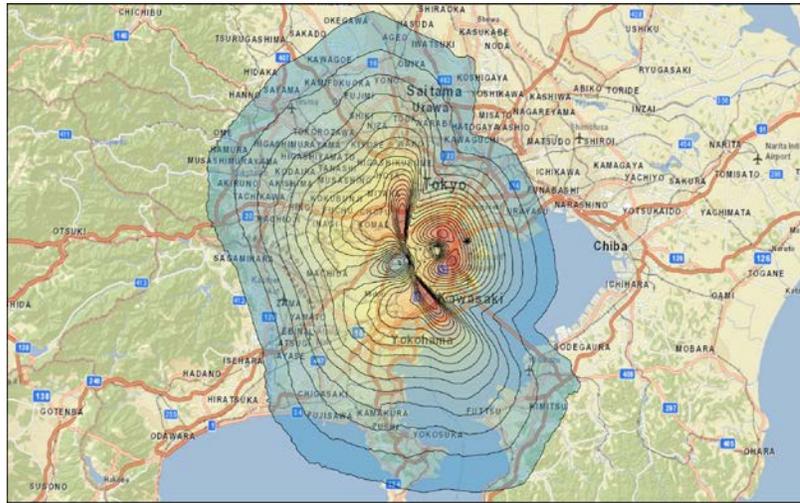
Damage area is insensitive to energy deposition height

12km

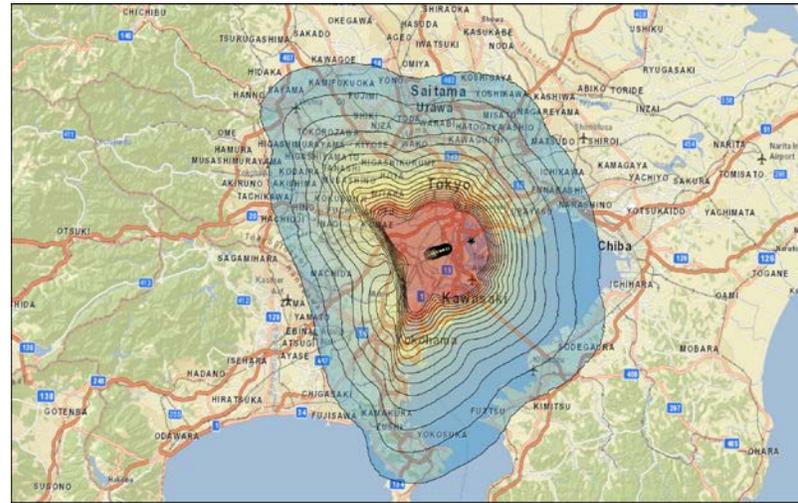
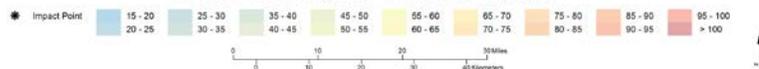
6km

Ground Impact

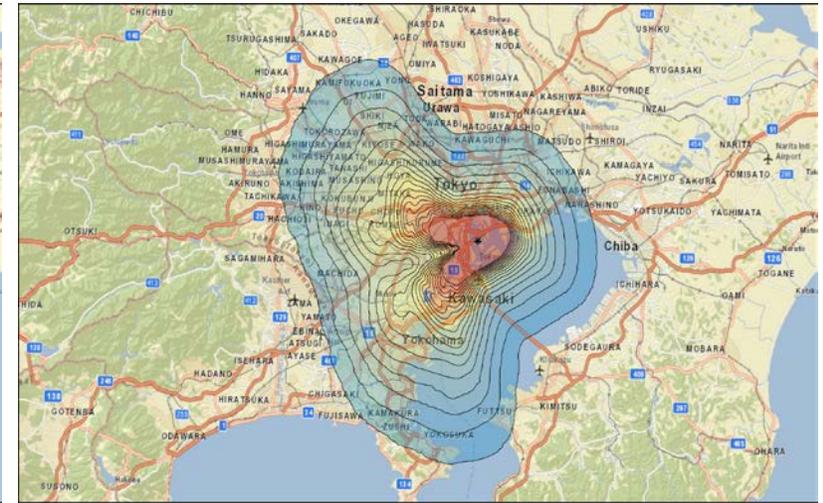
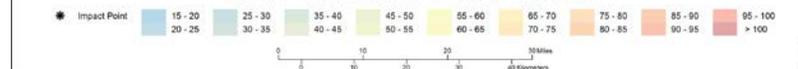
WIND



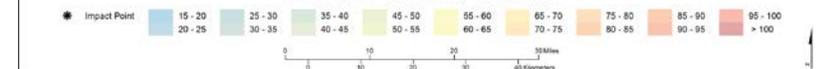
Air Burst - 12km above ground - Winds (m/s) - Tokyo, Japan



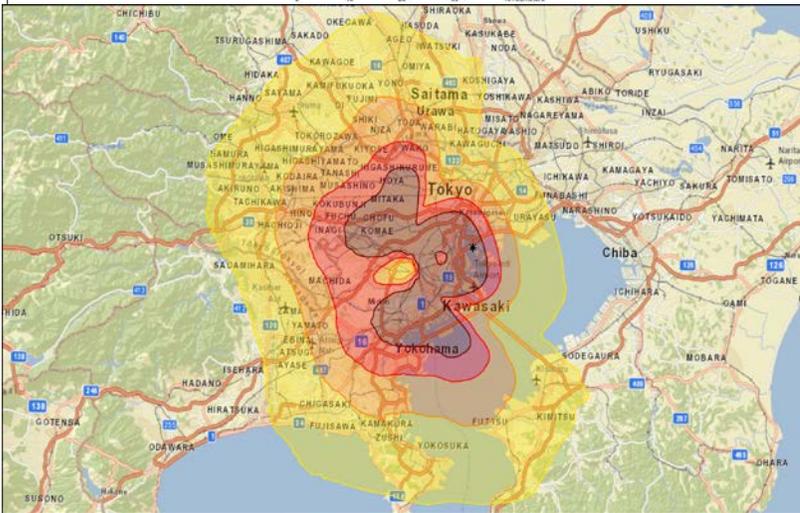
Air Burst - 6km above ground - Winds (m/s) - Tokyo, Japan



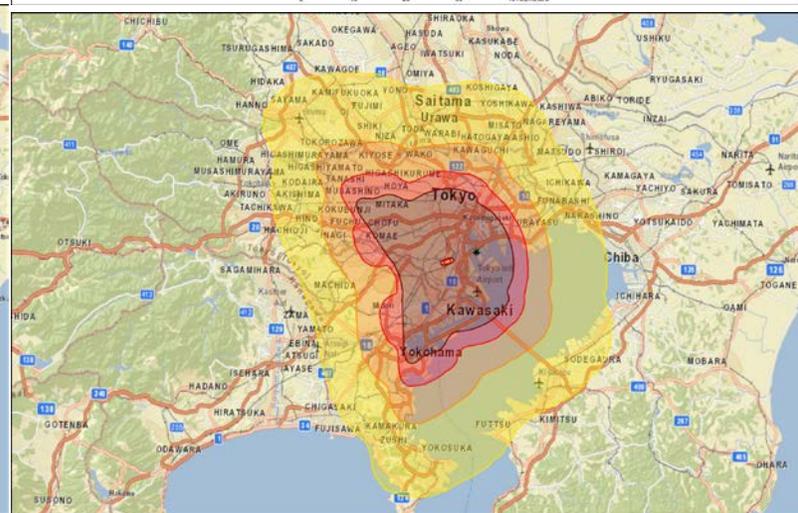
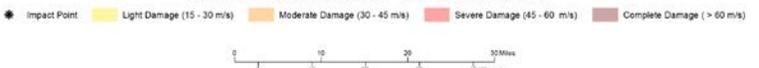
Ground Impact - Winds (m/s) - Tokyo, Japan



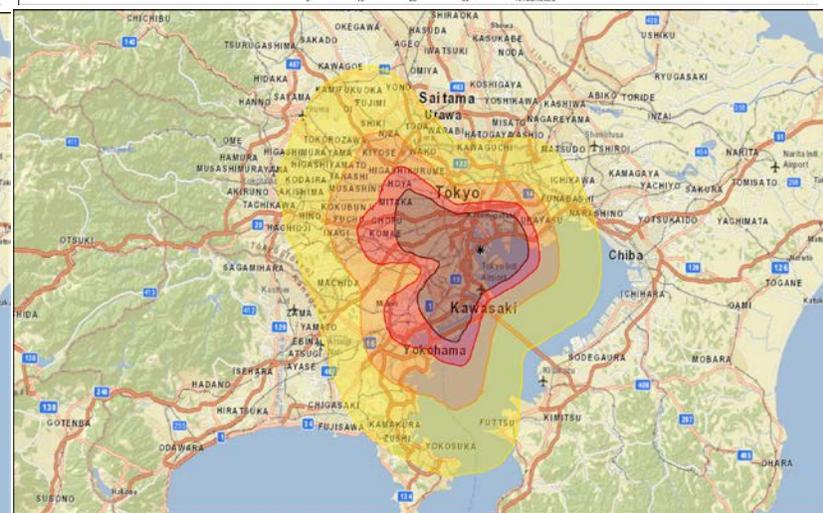
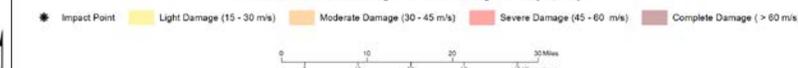
Damage Zones



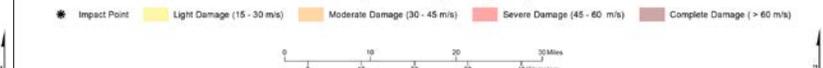
Air Burst - 12km above ground - Damage - Tokyo, Japan



Air Burst - 6km above ground - Damage - Tokyo, Japan



Ground Impact - Damage - Tokyo, Japan



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Windows shatter (km)	112	>0.98	>35

Damage Description	Tokyo, Japan		
	12 km Airburst	6 km Airburst	Ground Impact
Light Damage (15 - 30 m/s)	7,731,379	7,948,603	7,459,451
Moderate Damage (30 - 45 m/s)	5,286,166	4,254,809	4,210,800
Severe Damage (45 - 60 m/s)	4,590,846	2,409,942	2,620,167
Complete Damage (> 60 m/s)	4,799,187	6,583,381	4,700,281
TOTAL	22,407,578	21,196,735	18,990,699