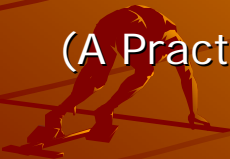


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Gary S. Makasiar

◆ **AN ALTERNATIVE PARADIGM FOR
POWER PRICING, ECONOMICS, AND
PLANNING**

(A Practitioner's Odyssey)



G. Makasiar 1

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Makasiar Diagrams

an

¢/kW

FUNDAMENTAL STARTING CONCEPTS
AN ALTERNATIVE ALGORITHM FOR THINKING ABOUT POWER
PRICING, ECONOMICS AND PLANNING

A. THE **FUNDAMENTAL STARTING CONCEPTS**

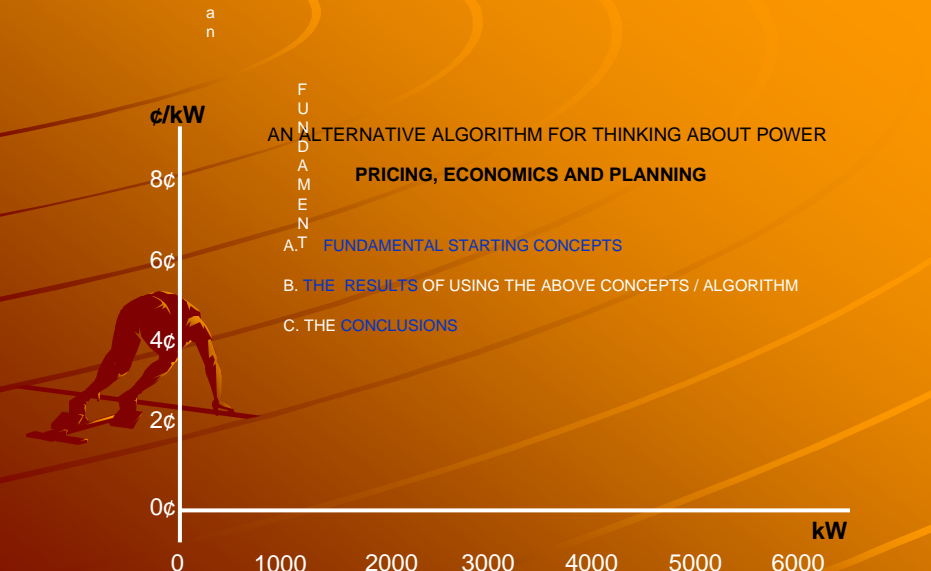
B. THE **RESULTS** OF USING THE ABOVE CONCEPTS / ALGORITHM

C. THE **CONCLUSIONS**

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A. FUNDAMENTAL STARTING CONCEPTS

1. POWER IS AN INSTANTANEOUS COMMODITY

- a. Very expensive to store
- b. Preferably consumed at the instant produced

2. THE POWER COMMODITY IS WATTS (or its multiples)

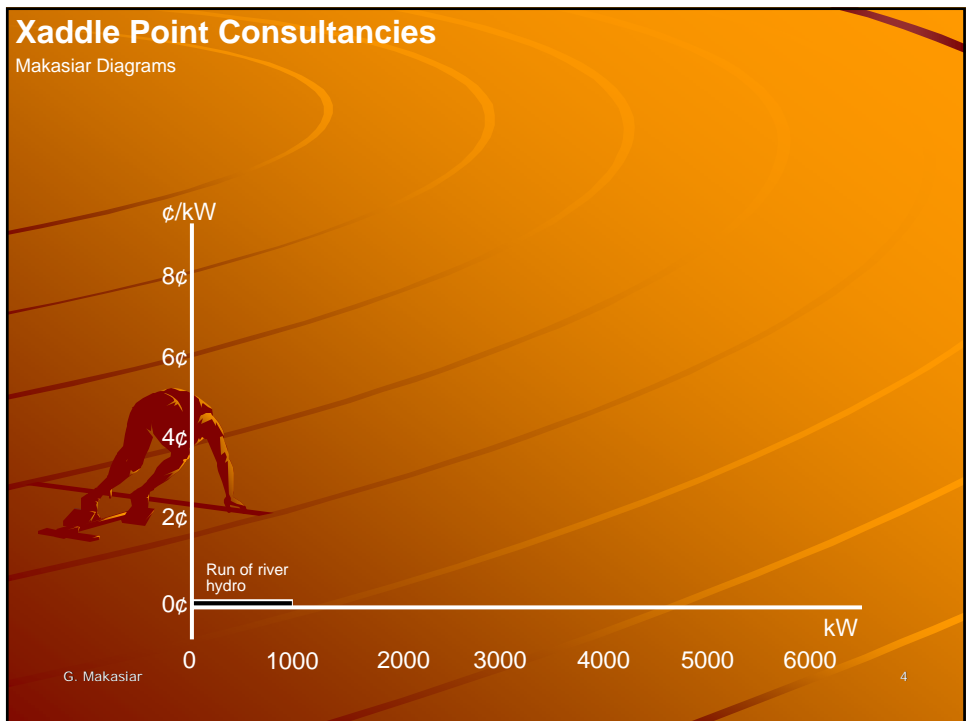
- a. NOT the kilowatt-hours, many of us are accustomed to thinking .
- b. It is power produced or consumed at an instant or incremental unit of time.
- c. In other words, KW per unit (incremental interval) of time.
- d. By convention or for practical purposes, we use "hour" as the incremental interval.
- e. Which brings us to "KWs over a particular hour" or KW / hour., if you will.

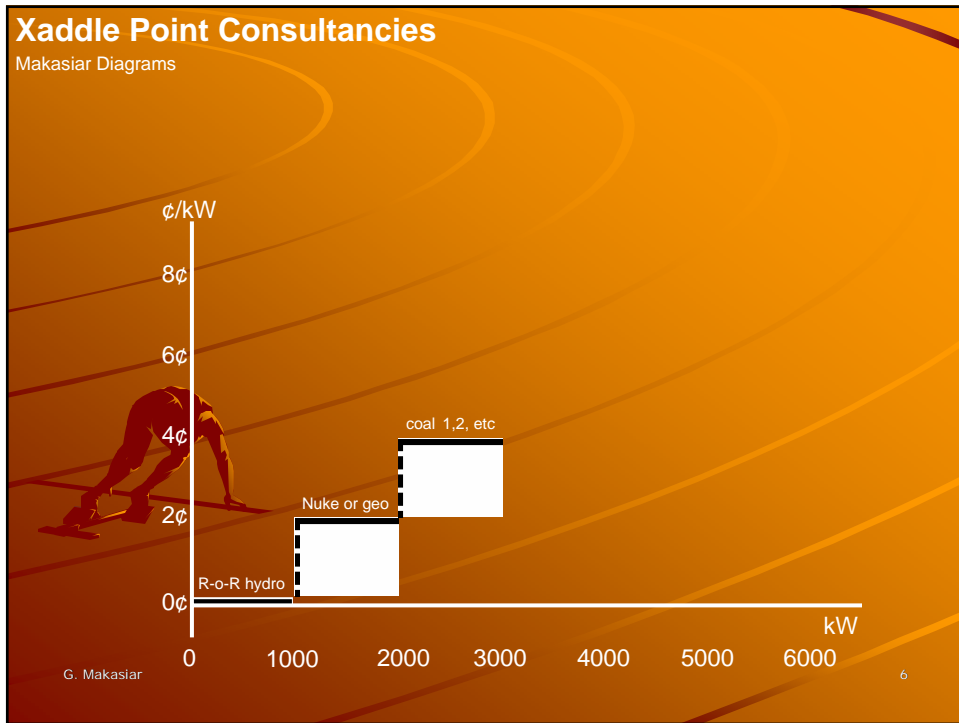
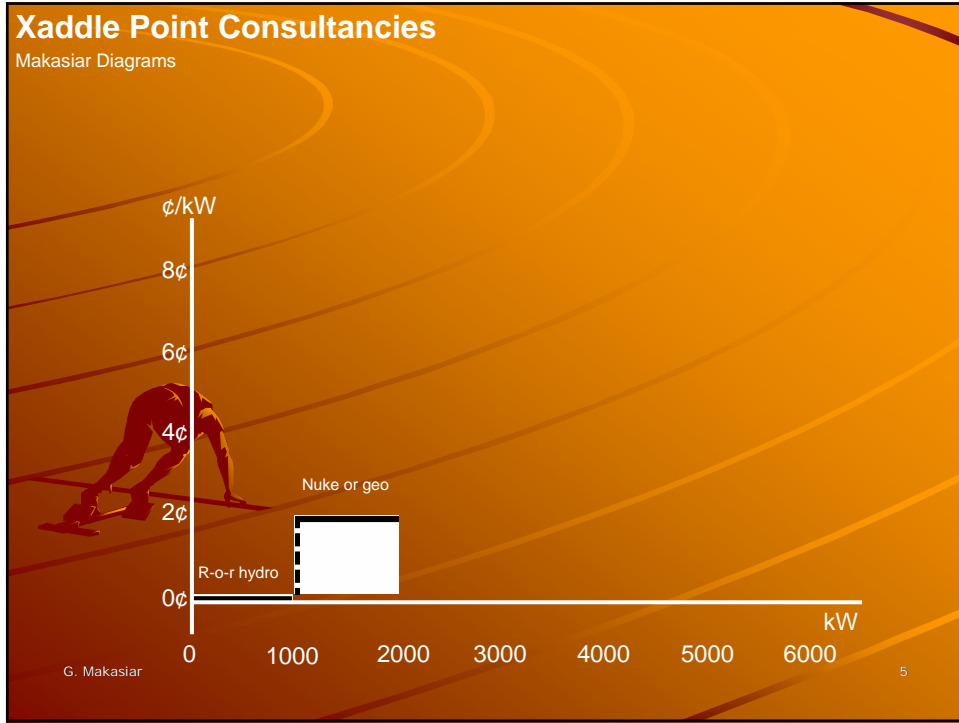
KW/h

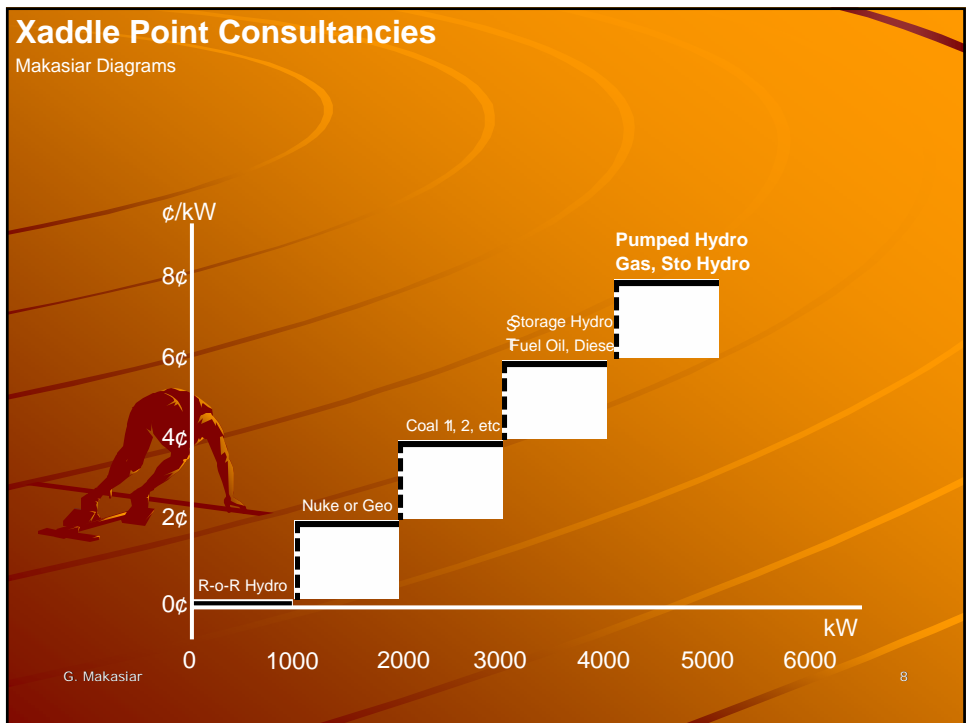
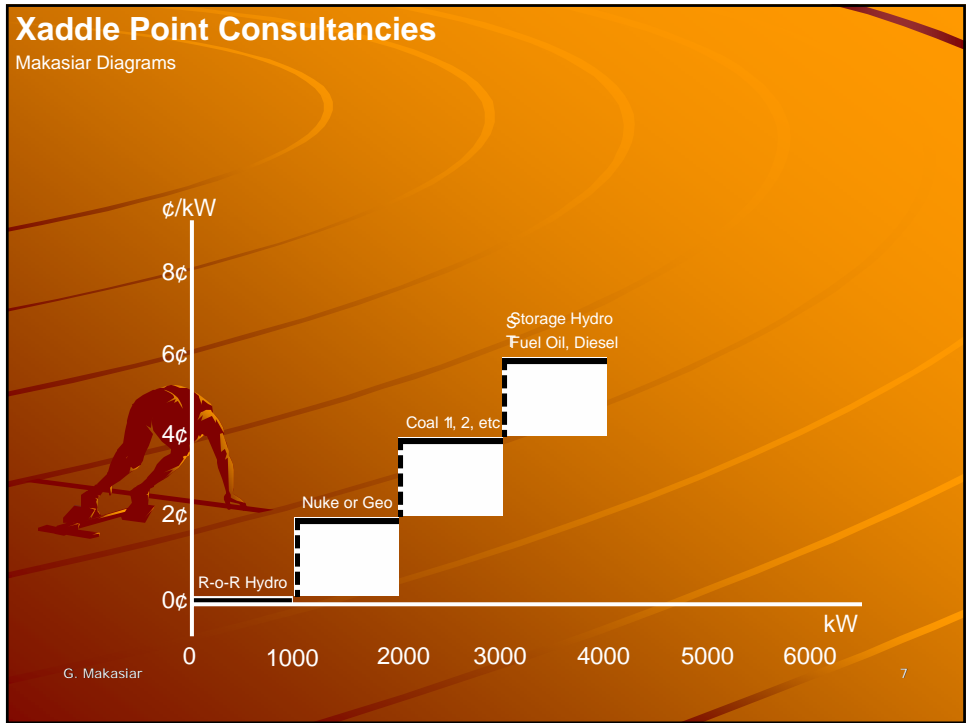
KW

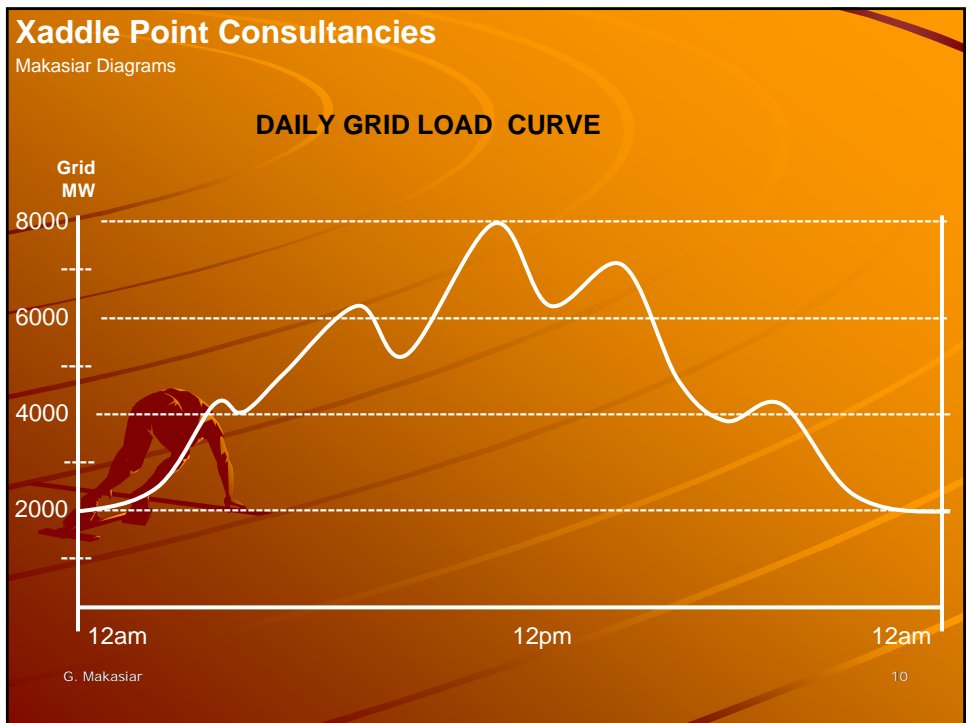
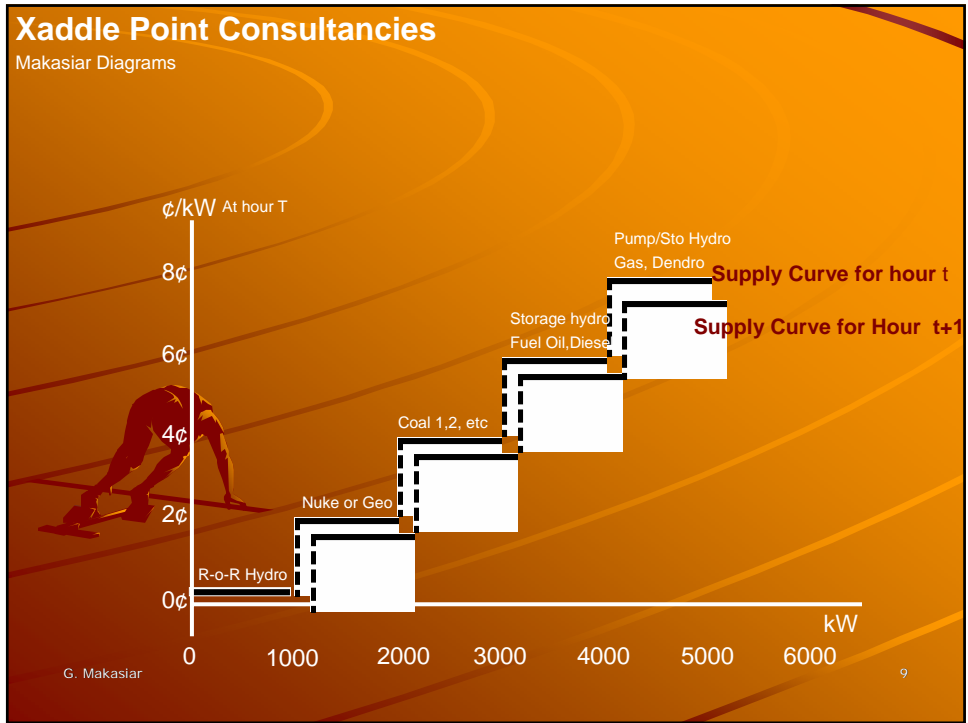
Cents/KW

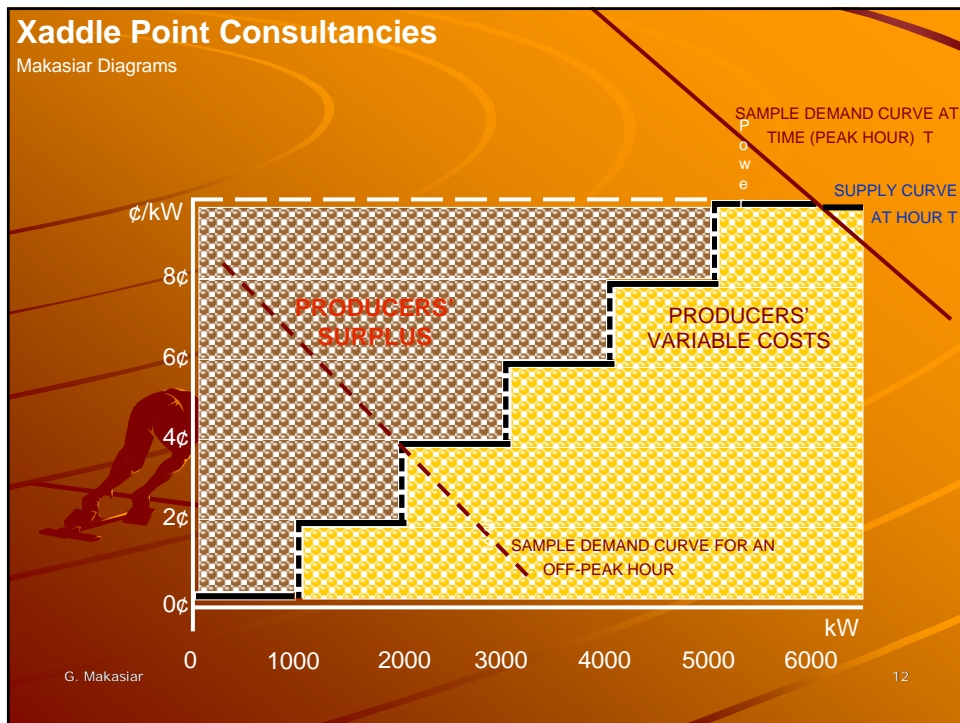
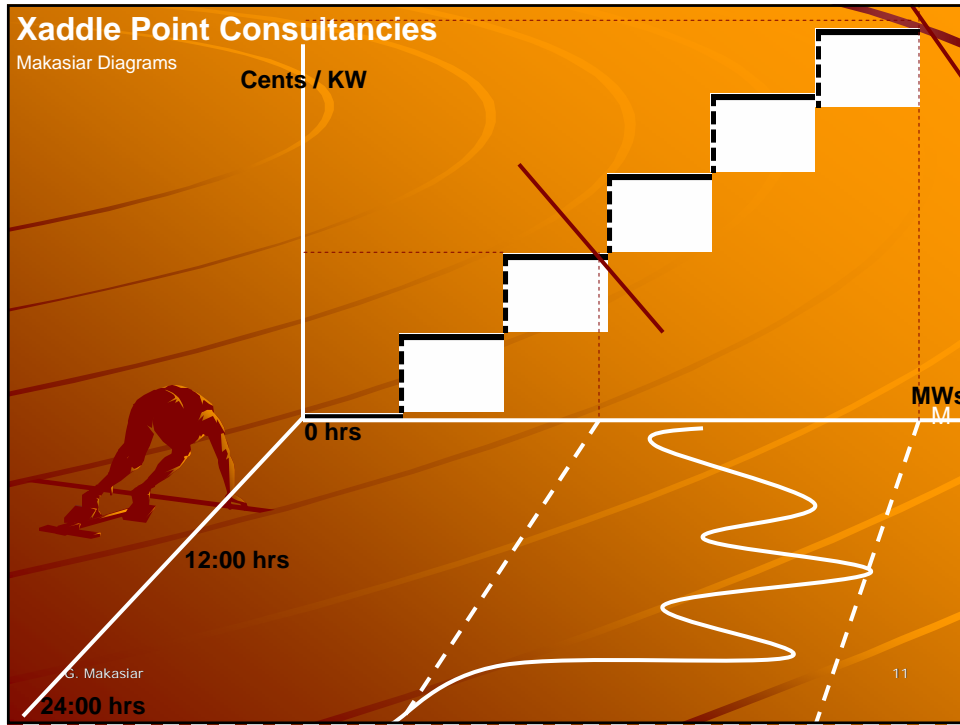
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cents/kw

cent

B. THE RESULTS OF USING THE ABOVE CONCEPTS / ALGORITHM

1. UPWARD-"sloping" supply ciuves, NOT the textbook downward sloping curves .
2. Supply point elasticities totally dominate demand point elasticities..
3. There is NOT ONE efficient price of power, but at least as many as the time intervals used.
4. Price is allocation and expansion efficient at $P=MC$ or $SRMC$, for every interval of time.

K
W, KW

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cents/kw

C. THE CONCLUSIONS

1. The only remaining reform needed. H.O.U.R.(hour of use rate) pricing.
2. Traditional Monopolies in the Power Industry serve some useful/developmental purpose.
3. Reform initiatives could have taken different directions, Hopefully, less difficult and awkward.
4. Need for establishing a wpsm less urgent. The Grid is already an Exchange.
5. Marginal cost pricing not only efficient but helps prevent monopoly abuse.
6. MC-pricing is easy to police. Makes for a more vigilant public to even check on ERC.

KWs

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NOTES ON POWER PLANNING

A. POWER CAPACITY PLANNING

1. RECOGNIZE: DIFFERENT TYPES OF PLANTS ARISING FROM UNIQUE SUPPLY TECHNOLOGIES, EXTERNALITIES AND CONSTRAINTS

a. **Base-load Plants** –Normally, not always, High Absolute and Per KW Capital Costs, but low variable costs. High Plant or capacity factor (loves long continuous year-round operations, hates intermittent type of operation). Incl run-of-river or spilling storage hydro, nuke, geo, coal, hydrogen, fusion, OTEC etc)

b. **Intermediate Plants** - Can tolerate lower plant factors and intermittent operations. Medium-level variable costs (storage hydro, diesels, dendrothermals, older or smaller thermal units)

c. **Peaking Units** – Generally, not always, Low Absolute or Per KW Capital Costs but higher variable costs, Ususally resorted to, to acute structural peaks or emergency / short-notice spikes in peak hour demand that cannot be met using other baseload or intermdiate plants.

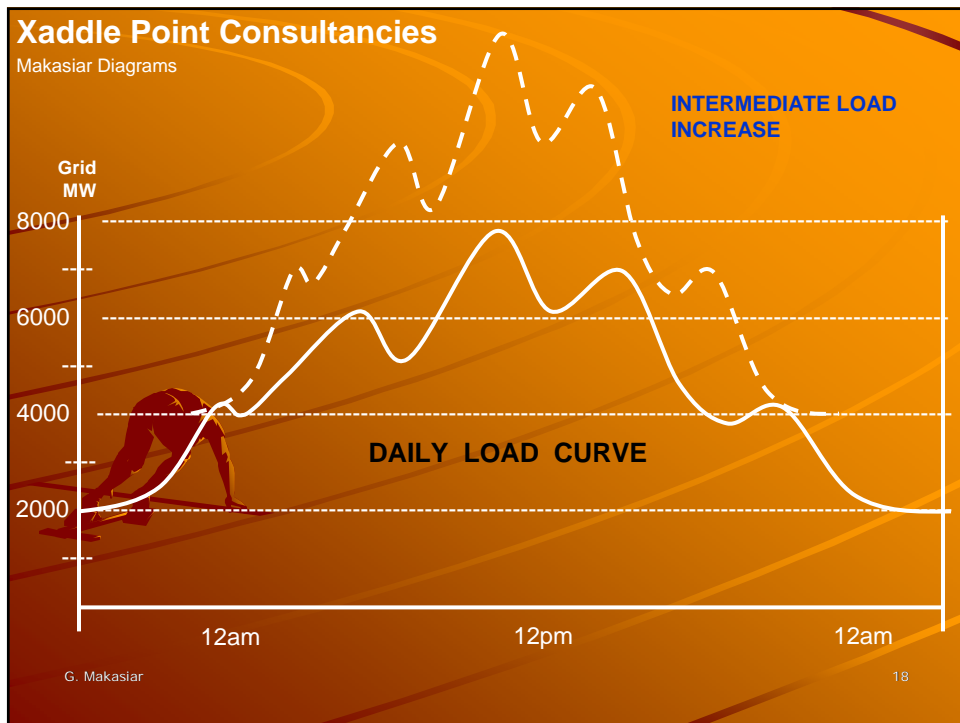
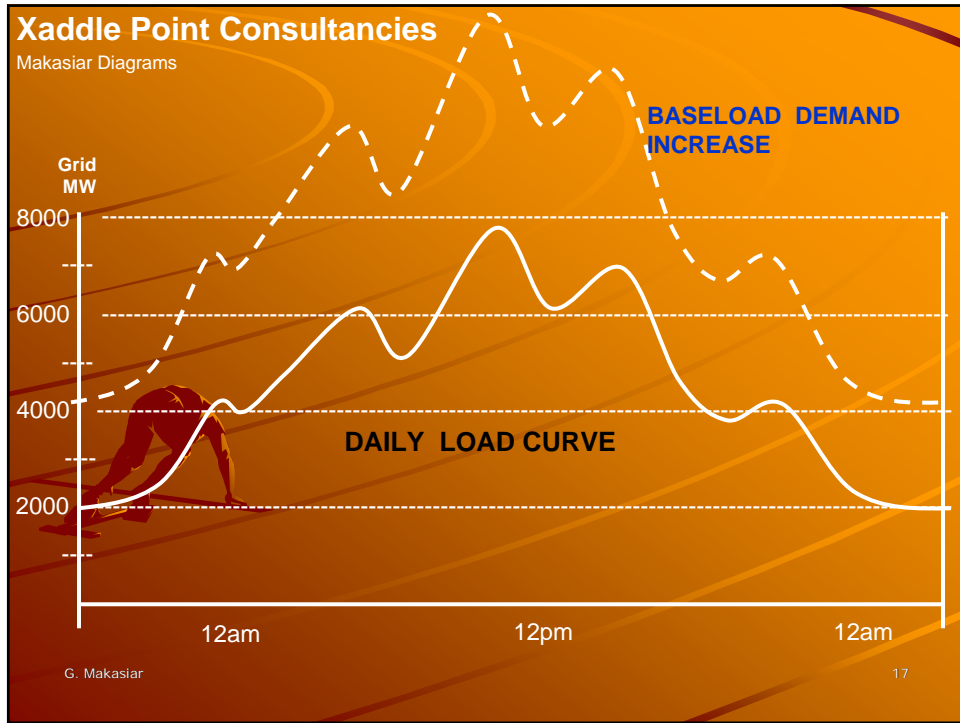
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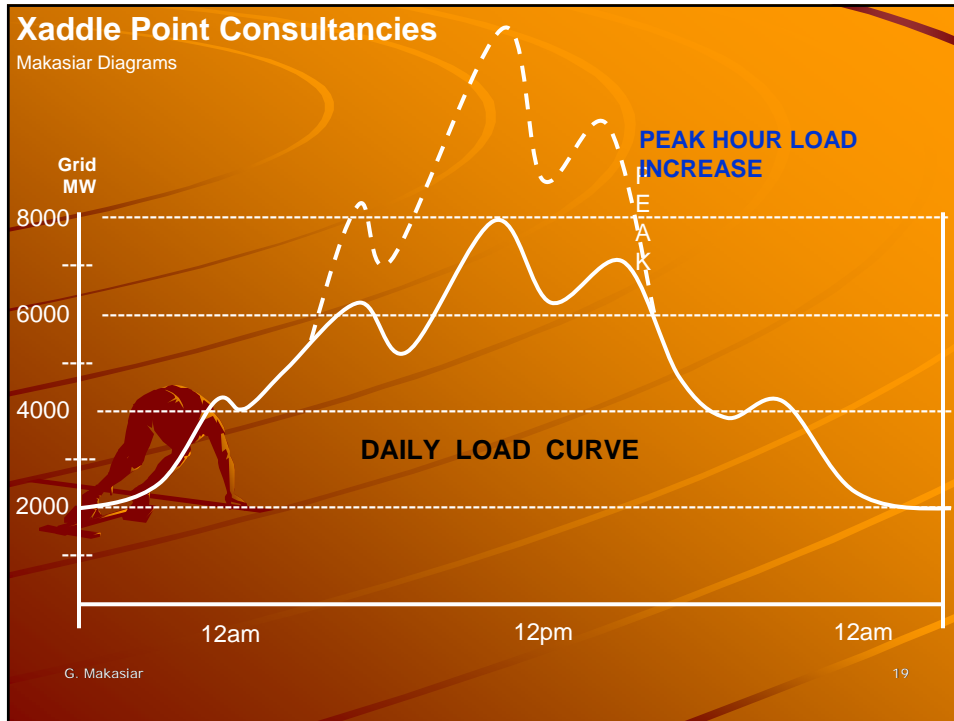
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A FOOTNOTE ON HYDRO POWER

- MANY ARE OFTEN LED TO BELIEVE HYDRO POWER IS **CHEAP** BECAUSE THE WATER IS SAID TO COME FREE FROM RAINFALL.
- THIS IS PROBABLY **LESS TRUE FOR STORAGE HYDRO** PROJECTS, AND PROBABLY LEAST TRUE FOR PUMP STORAGE HYDRO PROJECTS IF THERE IS NO SIGNIFICANT EXCESS NUKE OR COAL CAPACITY DURING OFFPEAK HOURS.
- WHY?
 - BECAUSE WHILE THE WATER MAY BE FREE, STORAGE DAMS SUBMERGE **VAST TRACTS OF LAND** THAT MAY ALREADY HAVE ALTERNATIVE USES (AGRI, PASTURELAND, SETTLEMENTS, ETC). ALSO NEEDS WATERSHED MAINTENANCE.
 - SECONDLY, WHERE **RAINFALL IS NOT YEAR-ROUND**, PLANT UTILIZATION MAY BE LOW FOR SUCH A CAPITAL-INTENSIVE INSTALLATION.
 - THIRDLY, STORAGE HYDRO PROJECTS ARE USUALLY **MULTI-PURPOSE** DAMS WHERE POWER LAGS THIRD BEHIND WATER SUPPLY AND IRRIGATION FOR PRIORITIZING WATER RELEASE. CROSS-SUBSIDY.
 - IN THE CASE OF PUMPING, **RECOVERY ONLY ¾** OF THE ENERGY USED

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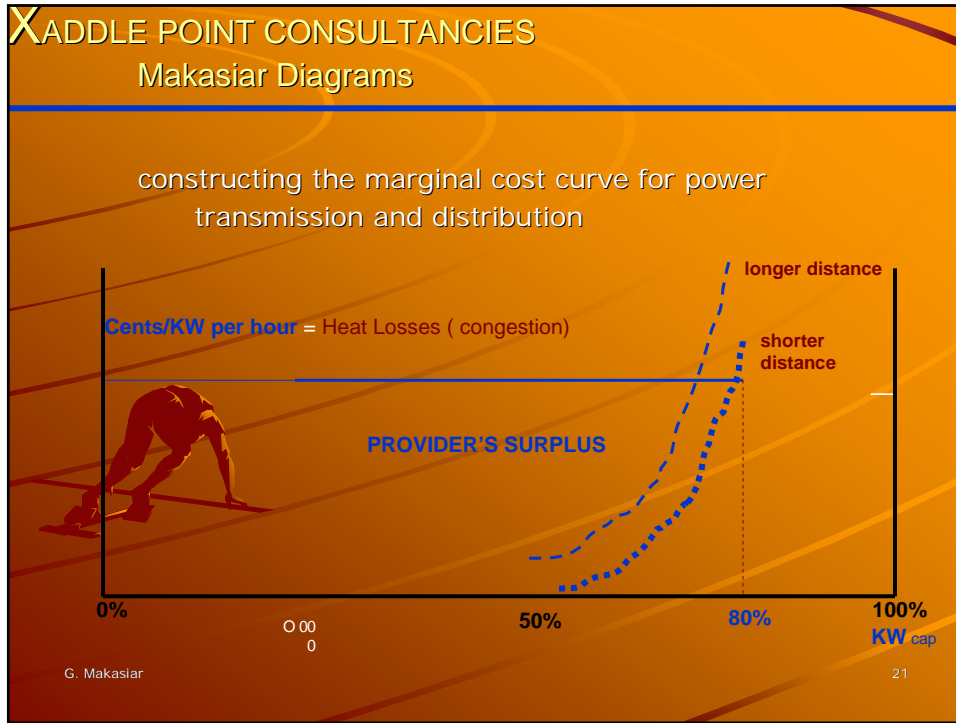


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MORE NOTES ON POWER PLANNING: DEMAND PROJECTIONS

1. BASING POWER CAPACITY PLANNING ON TRADITIONAL LONG-TERM PROJECTIONS OF PEAK DEMAND ALONE COULD BE MISLEADING.
2. THERE IS NEED TO SEPARATELY PROJECT GROWTH IN BASELOAD DEMAND, IN INTERMEDIATE DEMAND, AND IN PEAK DEMAND AND DETERMINE AT WHAT HOURS THERE IS COINCIDENTAL OCCURRENCE AND THE LEVEL OF THE COMBINED INCREMENT. IT IS ALWAYS USEFUL TO DO 20-YR FORWARD PLANNING, FIRM FOR THE FIRST FIVE YEARS AND INDICATIVE FOR THE NEXT FIVE, AND EXPLORATORY FOR THE LAST TEN. PLANS SHOULD BE UPDATED EVERY YEAR. THE H.O.U.R PRICING APPROACH WILL MINIMIZE UNDER AND OVER INVESTMENTS IN CAPACITY.
3. OPTIMAL CAPACITY PLANNING SOLUTIONS WILL DEPEND ON WHETHER PEAK DEMAND GROWTH IS EXPECTED TO EXCLUSIVELY ARISE FROM AN INCREMENT IN BASELOAD DEMAND, OR AN INCREMENT ON COINCIDENT INTERMEDIATE LOAD, OR AN INCREMENT IN PEAK DEMAND ALONE, OR ON ANY COINCIDENT COMBINATION OF ALL THE ABOVE.
 - A. HIGHER PEAK LOADS ARISING FROM BASELOAD DEMAND GROWTH THAT CANNOT BE MET BY EXCESS BASELOAD POWER CAPACITY, WILL PROBABLY REQUIRE INVESTMENTS IN ADDITIONAL BASELOAD POWER TECHNOLOGIES LIKE R-O-R HYDRO, GEOTHERMAL, NUCLEAR OR COAL PLANTS. THESE TECHNOLOGIES NORMALLY FEATURE HIGHER FRONT-END CAPITAL COSTS PER KW OF CAPACITY BUT VERY LOW VARIABLE (FUEL PLUS CONSUMABLES) COSTS. SUCH PLANTS ALSO USUALLY TAKE LONGER TO CONSTRUCT AND COMMISSION, SO LONGER PLANNING LEADTIME IS THEREFOR REQUIRED. FOR MOST OF THESE PLANTS, SITE SELECTION IS FAIRLY CRITICAL DUE TO ENVIRONMENTAL CONCERNS, WATER DEPTH REQUIREMENTS, ADEQUATE FUEL AVAILABILITY ETC.
 - B. LOAD INCREMENTS OCCURRING MOSTLY THROUGHOUT INTERMEDIATE DEMAND HOURS, IN TURN THAT CANNOT BE MET BY EXCESS CAPACITY IN BASELOAD OR INTERMEDIATE POWER CAPACITIES, MAY BE BETTER MET BY FUEL OIL, DIESEL, DENDRO POWER OR PUMPED-STORAGE HYDROS. THESE PROJECTS REQUIRE MEDIUM TO LONGER TERM TERM IMPLEMENTATION AND ADVANCE PLANNING IS ALSO NECESSARY. SITE SELECTION IS CRITICAL FOR STORAGE HYDRO/MULTI-PURPOSE PROJECTS.
 - C. SHORT-NOTICE DEMAND SPIKES THAT LARGELY WORSEN ONLY PEAK-HOUR LOADS, AND CANNOT BE MET BY ANY EXCESS POWER PLANT CAPACITY, ARE PERHAPS BETTER ADDRESSED BY GAS TURBINE OR LIKE TECHNOLOGIES, WHOSE FRONT-END CAPITAL COSTS ARE COMPARATIVELY LOWER BUT WHOSE VARIABLE COSTS ARE FAIRLY HIGHER, AND WHOSE COMMISSIONING TIME ARE MUCH SHORTER THAN OTHER POWER PLANTS. LONGER PLANNING LEADTIME IS NOT AS CRITICAL A REQUIREMENT IN THIS CASE.
4. BASICALLY POWER EXPANSION JUST PUSHES OUR HOURLY SUPPLY CURVES RIGHT/DOWN-WARDS.

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THE END

- ◆ THANK YOU FOR LISTENING AND YOUR PATIENCE.
- ◆ QUESTIONS WILL BE ENTERTAINED DURING THE OPEN FORUM, TIME PERMITTING

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TECHNOLOGY EXTERNALITIES AND OTHER PROBLEMS

1. Hydro – Social Costs of Displacement, Silting, Cloud Stealing
2. Nuke - Environmental Hazards, Spent Fuels, Terrorist Target
3. Geo - Sulfur Emissions, Ground Subsidence, Depletion?
4. Coal - Carbon Dioxide/Sulfur Emissions, Ash Handling,
5. Agri-waste – Collection Problem, Soil Nutrition
6. Solar - Vast tracts of Land Needed, Utilization Factor
7. Wind - Intensity of f Wind Regimes Not Constant, Utilization
8. Fusion – Need to get Past laboratory
9. Fuel Cell – Awaiting commercial breakthrough
10. Oil and Gas - Has more valuable petrochemical/plastics and transport applications

IS THE POPULAR CLAMOR TO USE INDIGENOUS FUELS REALLY THAT IMPORTANT OR MEANINGFUL ? NOT IN THE CASE OF TRADEABLE FUELS.