Fusion Implementation Scenarios

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Socio-economics Aspects of Fusion Power
VLT Program Advisory Committee
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Fusion Scenario Development Objective

- Show that fusion can be an energy source for the 21st century
- Develop an understanding of the requirements for meeting this objective
- And the implications for resources and waste

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We Have Assessed Fusion Implementation Scenarios for Both the U. S. and the World

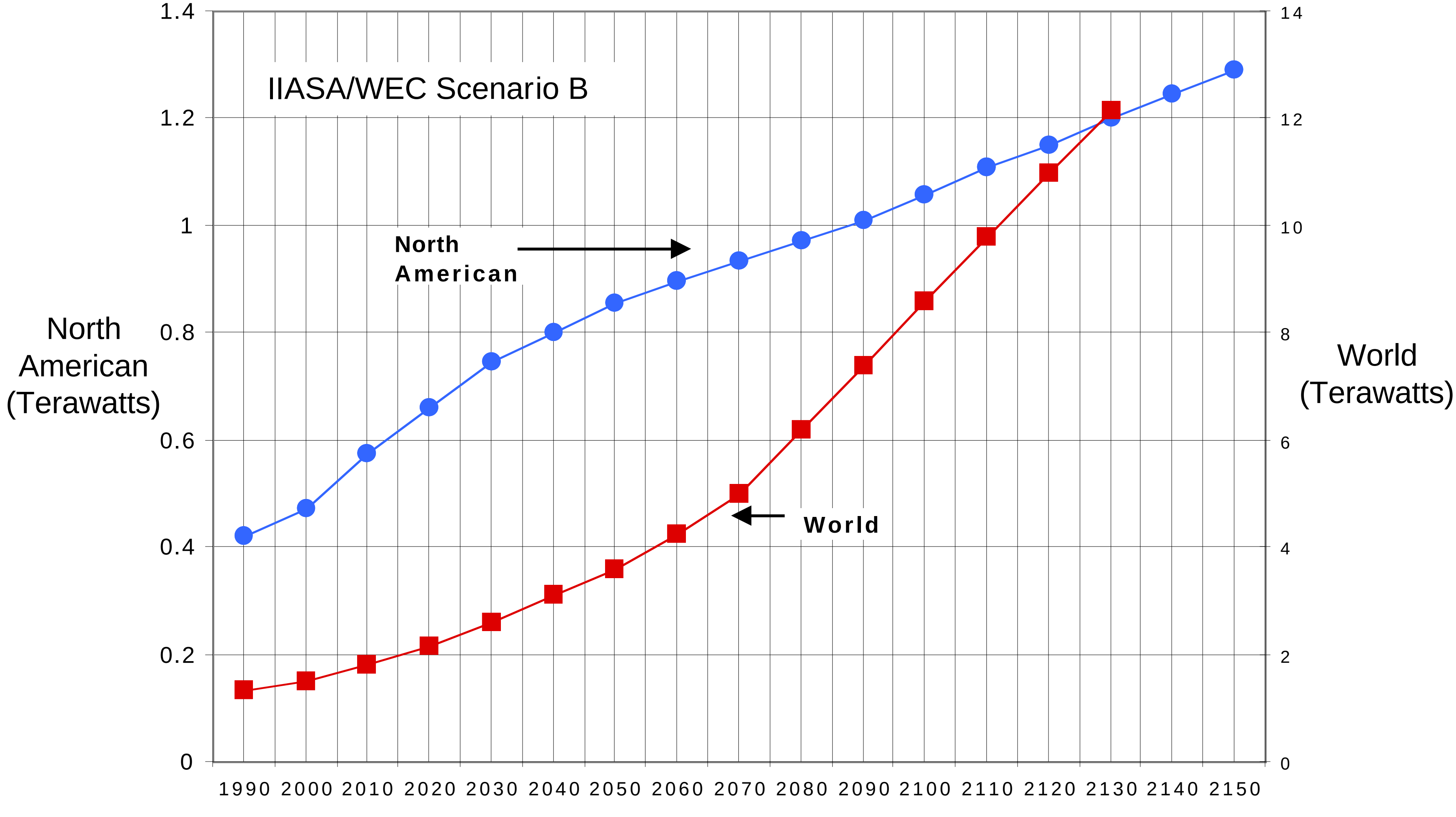
- We need to study fusion implementation in the U. S. to be able to communicate with our constituency.

- In addition, it is a little easier to extrapolate and relate to the U. S. energy future.

- To the extent that we want to illustrate impacts on atmospheric carbon dioxide we need to look at total world scenarios.

- Clearly the biggest growth in demand will be for the developing economies.

Electricity Production



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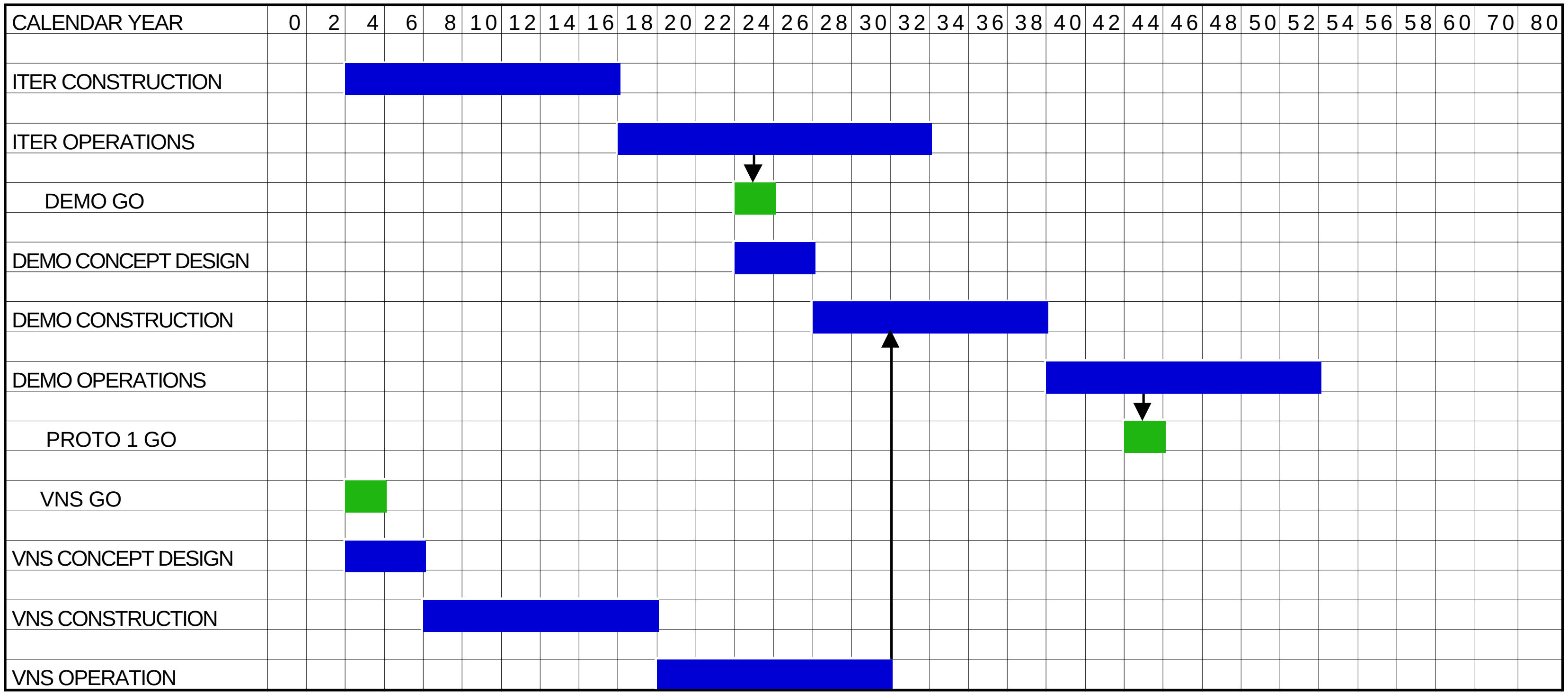
Fusion Development



Reference: "*Results of an International Study on a High-volume Plasma-based Neutron Source for Fusion Blanket Development*" Mohamed A. Abdou, Fusion Technology Vol. 29 Jan. 1996

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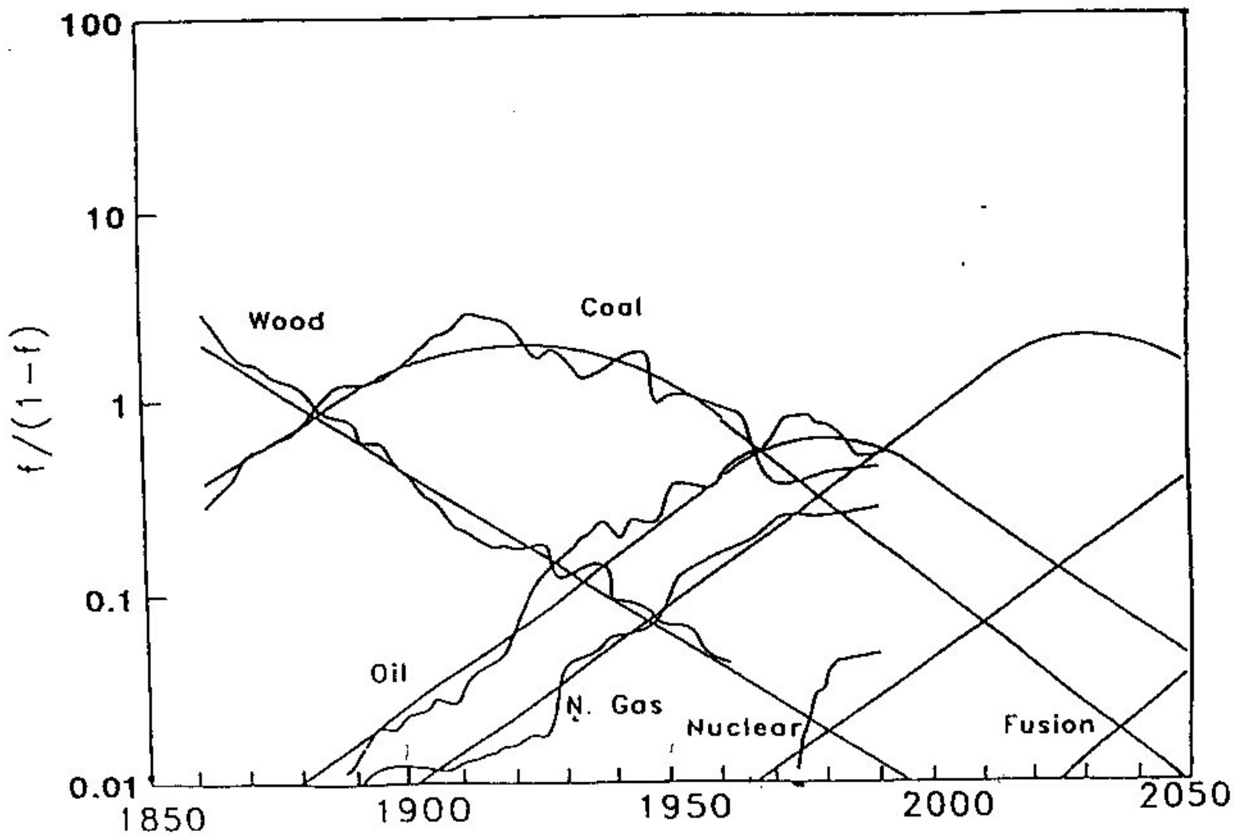
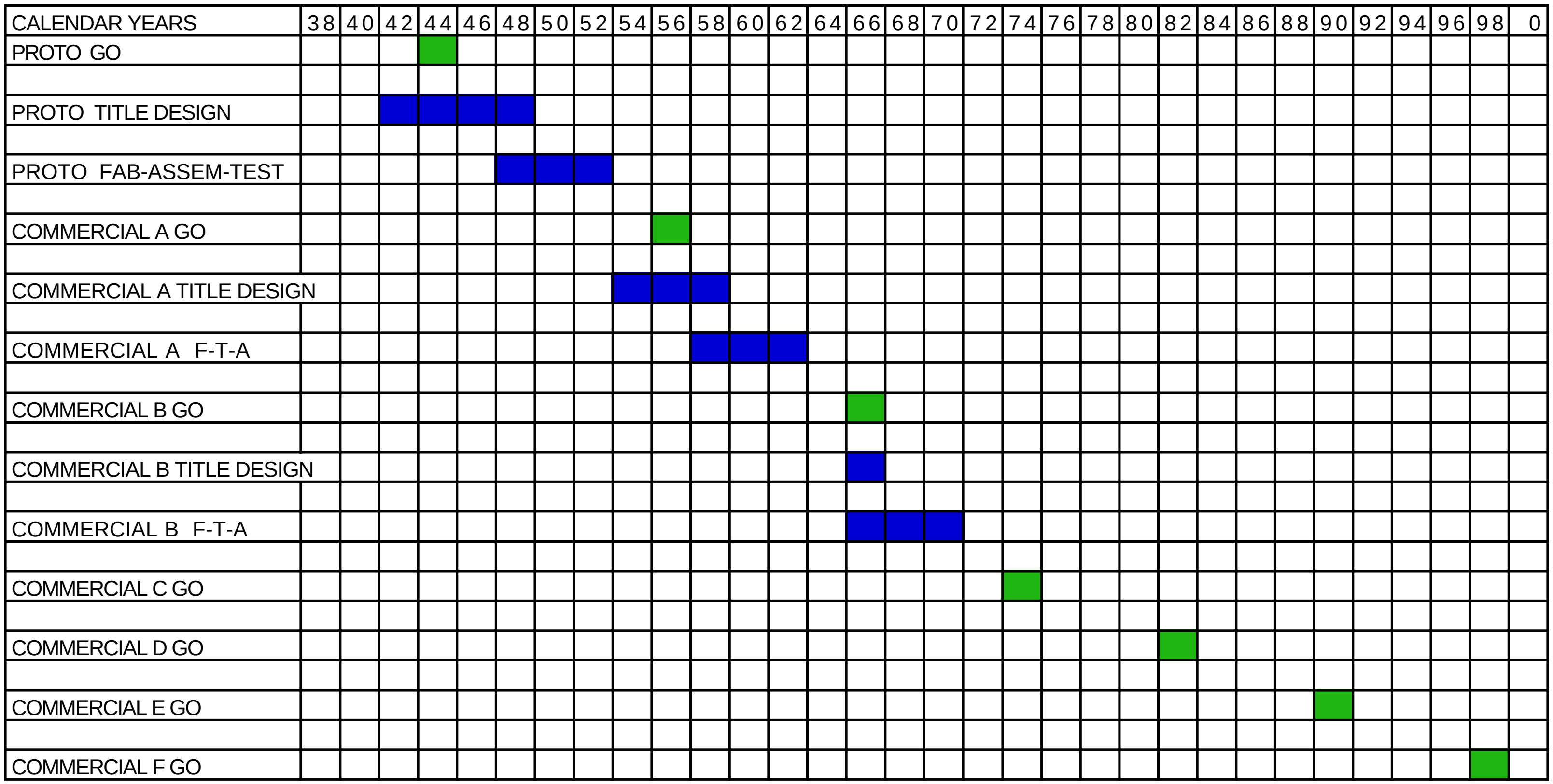


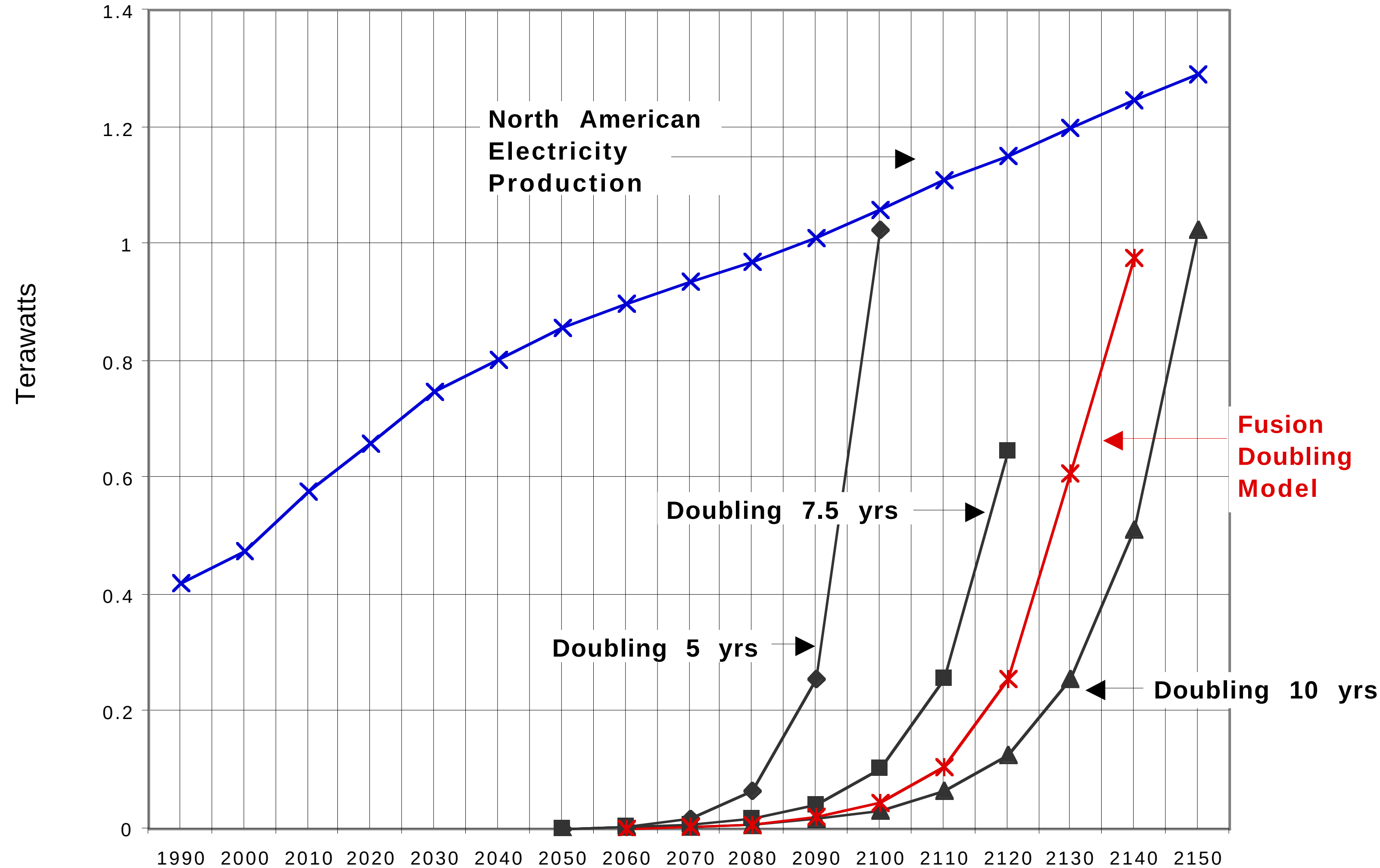
Fig. 5. Fraction, f, of world energy sources expressed as f/(1 - f).

Reference: C. Marchetti, Energy Supply, ABB/IEA GHG Forum, Baden-Dattwil, March 1997.

Fusion Development



Fusion Contributions to North American Electricity Production



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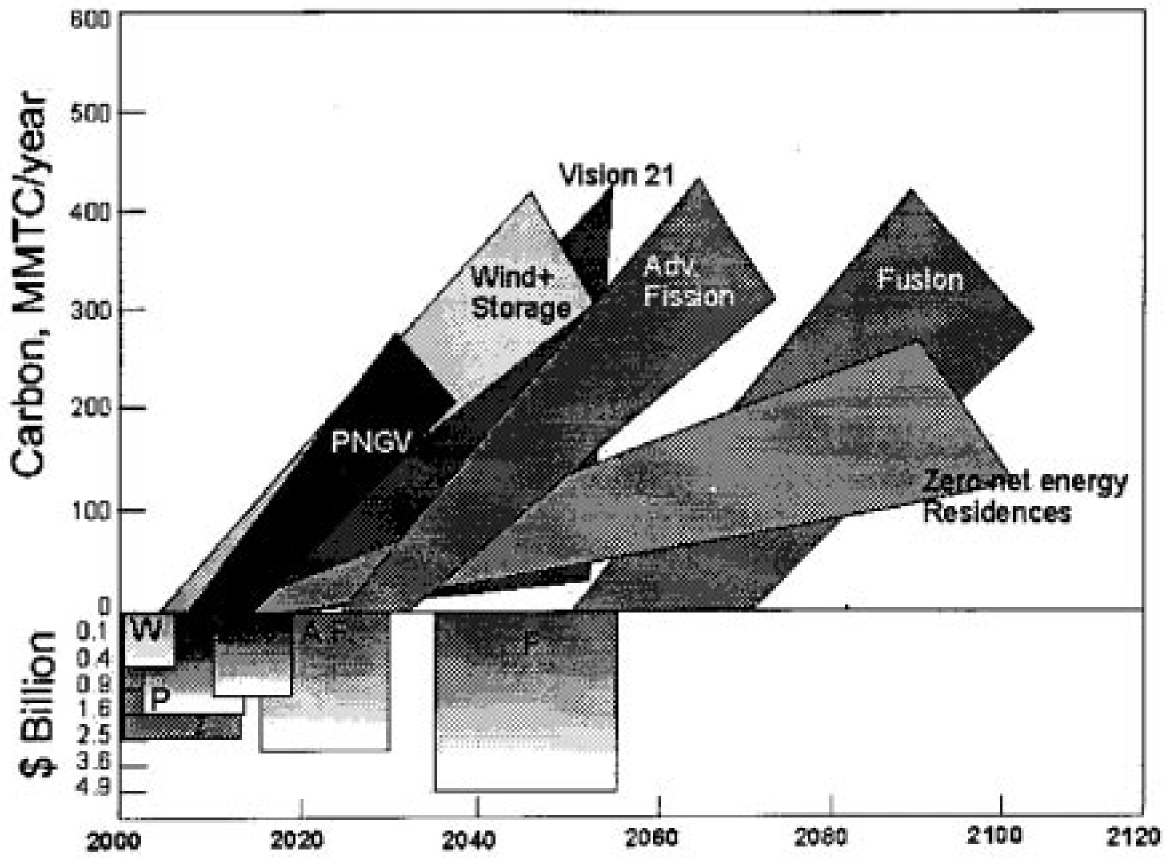
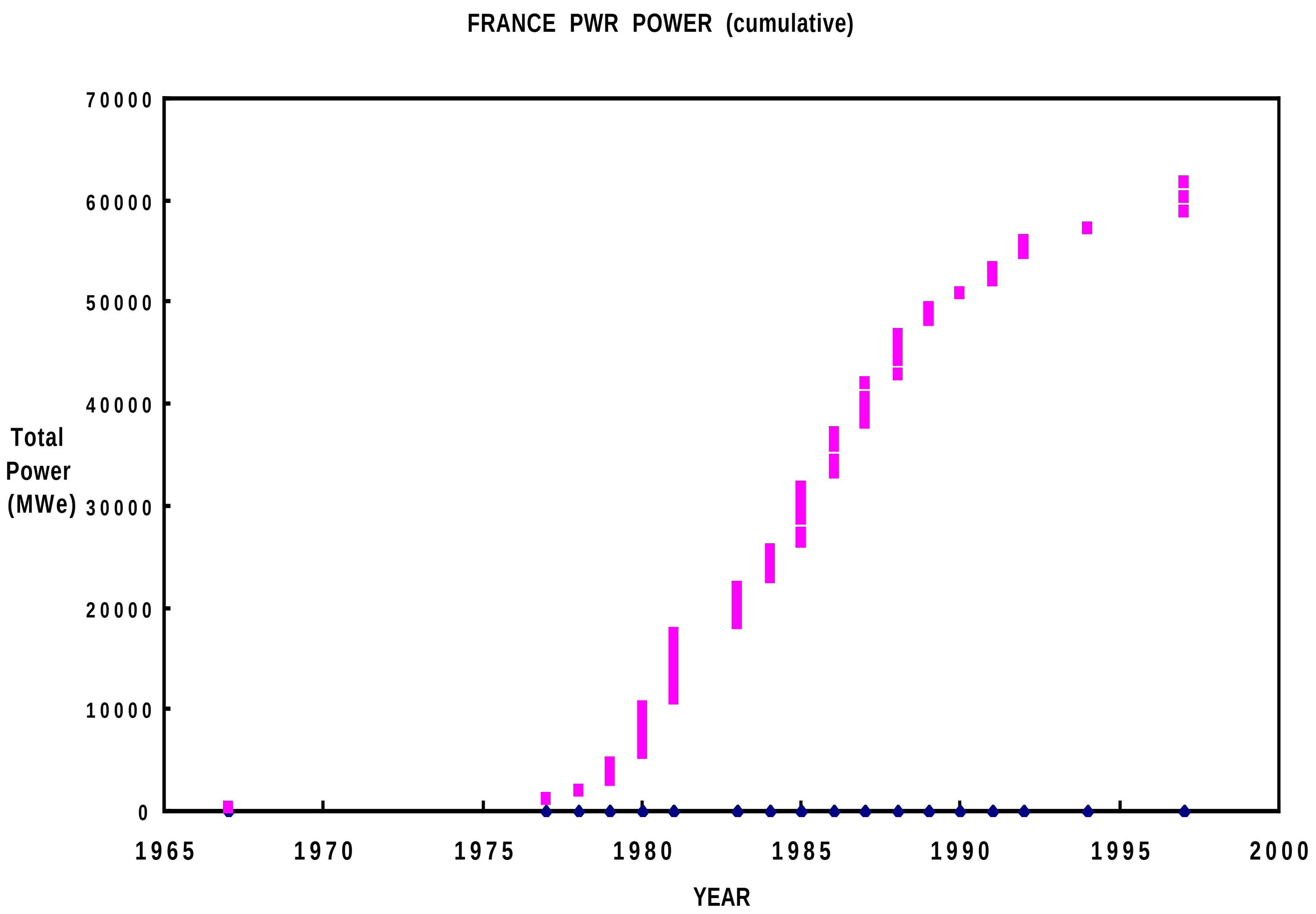
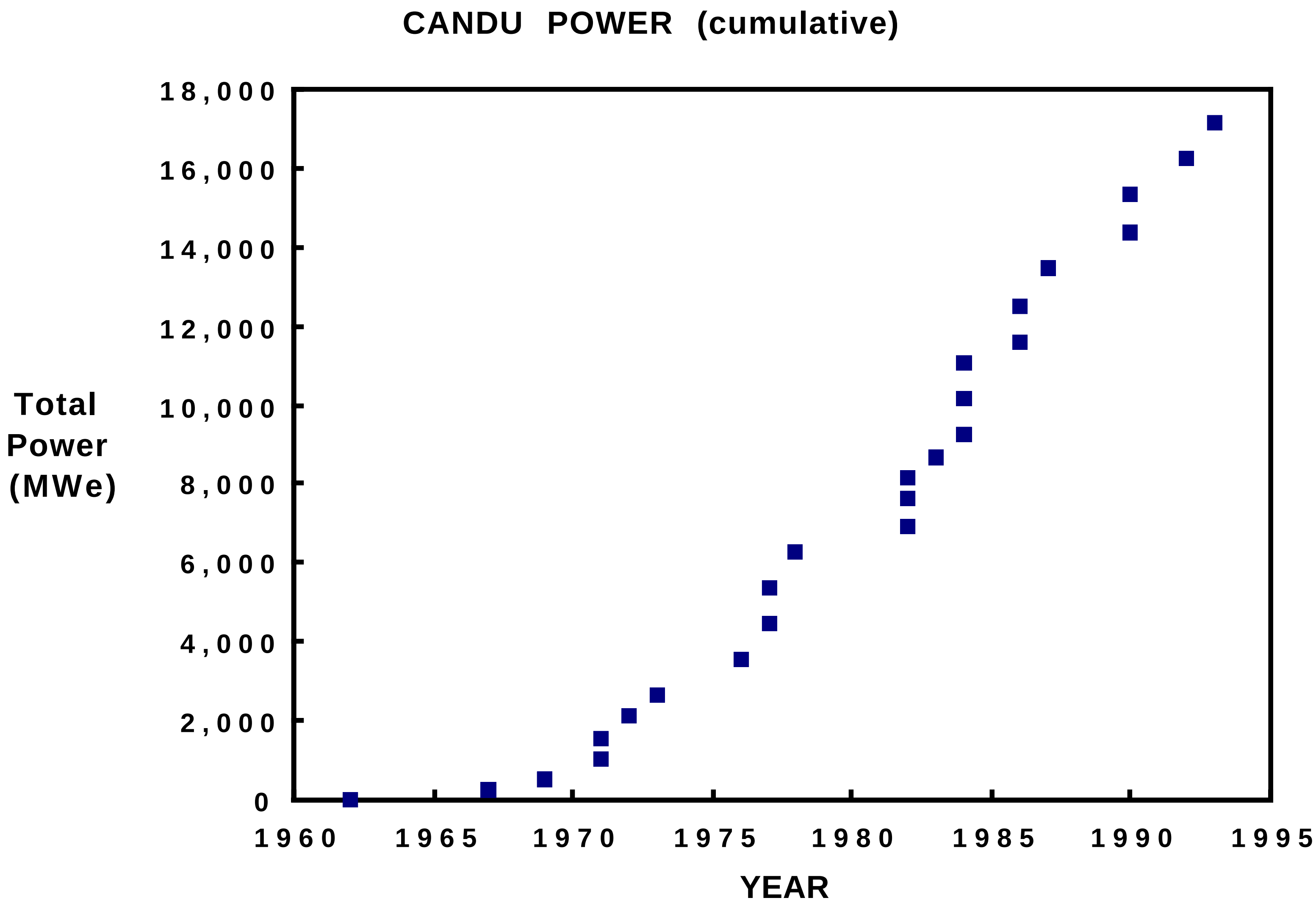
PCAST



Carbon, MMTC/year
600
500
400
300
200
100
0
Vision 21
Wind+
Storage
Adv.
Fission
Fusion
PNGV
Zero-net energy
Residences
$ Billion
0.1
0.4
0.9
1.6
2.5
3.6
4.9
W
P
A.F.
F
2000
2020
2040
2060
2080
2100
2120



FRANCE PWR POWER (cumulative)
Total Power (MWe)
70000
60000
50000
40000
30000
20000
10000
0
1965
1970
1975
1980
1985
1990
1995
2000
YEAR



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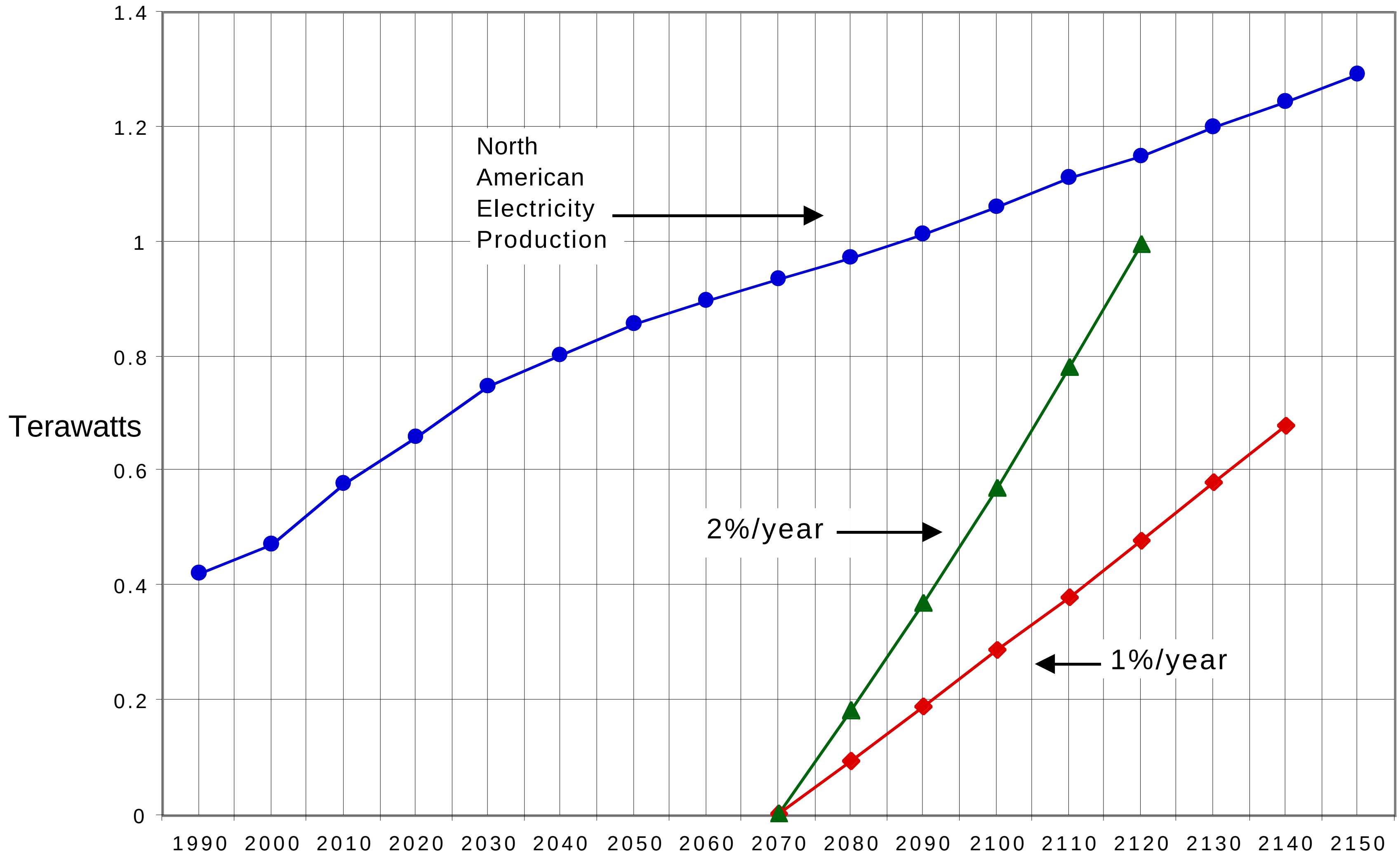
Precedents for Energy Technology Implementation

French Nuclear	7%/year
CANDU - ratio to Canadian Power	1%/year
CANDU - ratio to Ontario Power	4%/year

Fusion Contributions to North American Electricity Production



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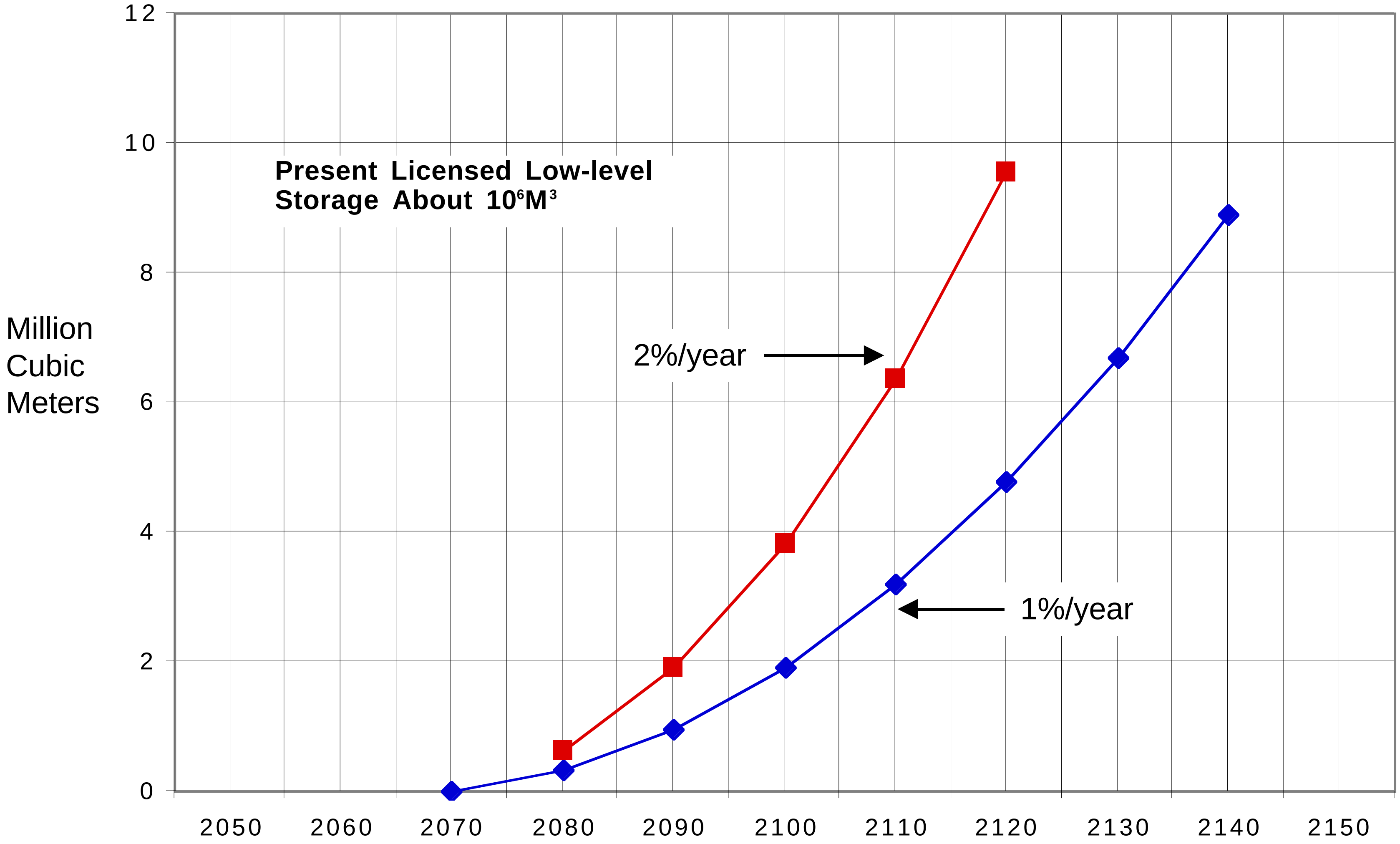
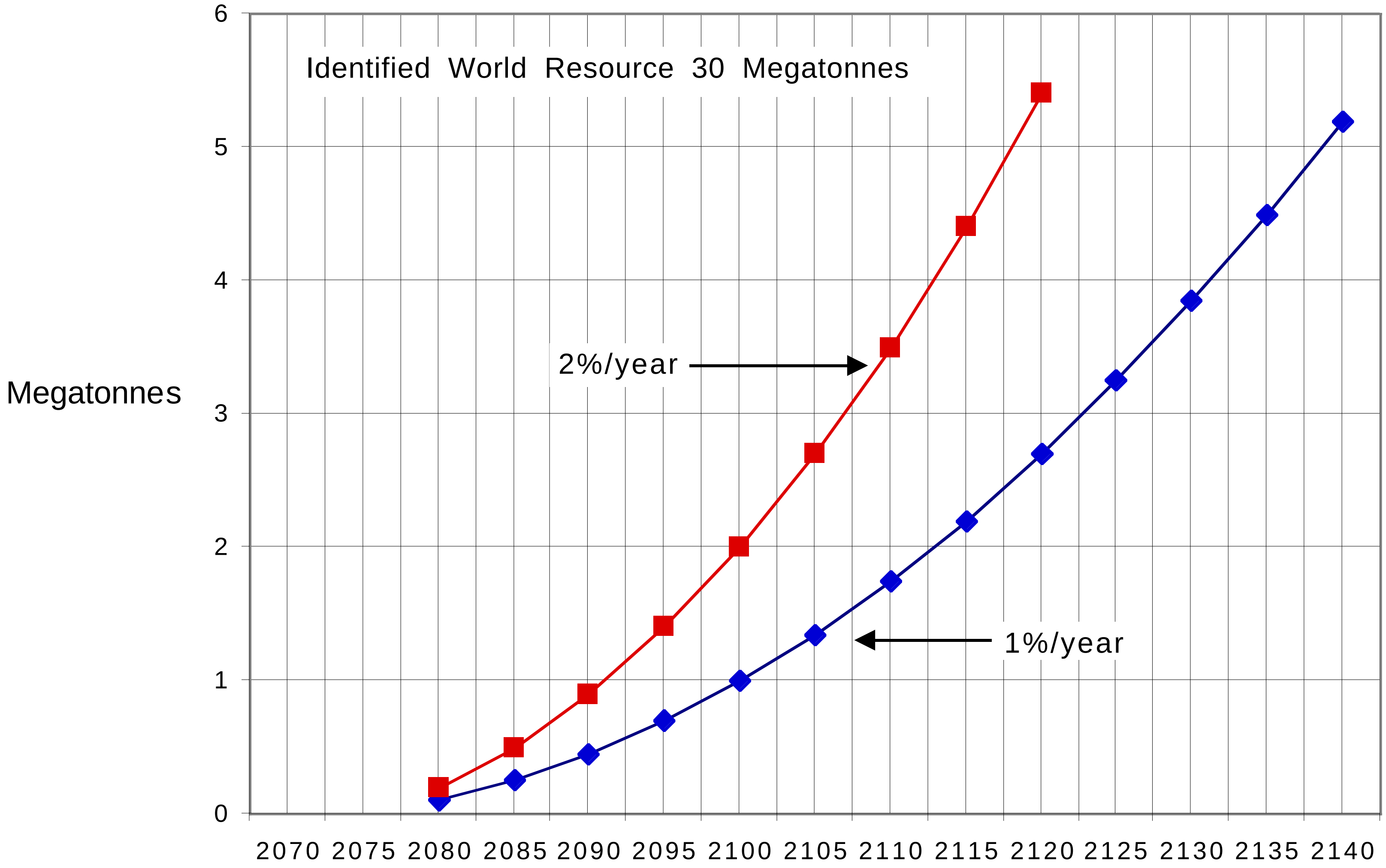
Activated Waste
(U.S. Implementation)



Total Vanadium Required



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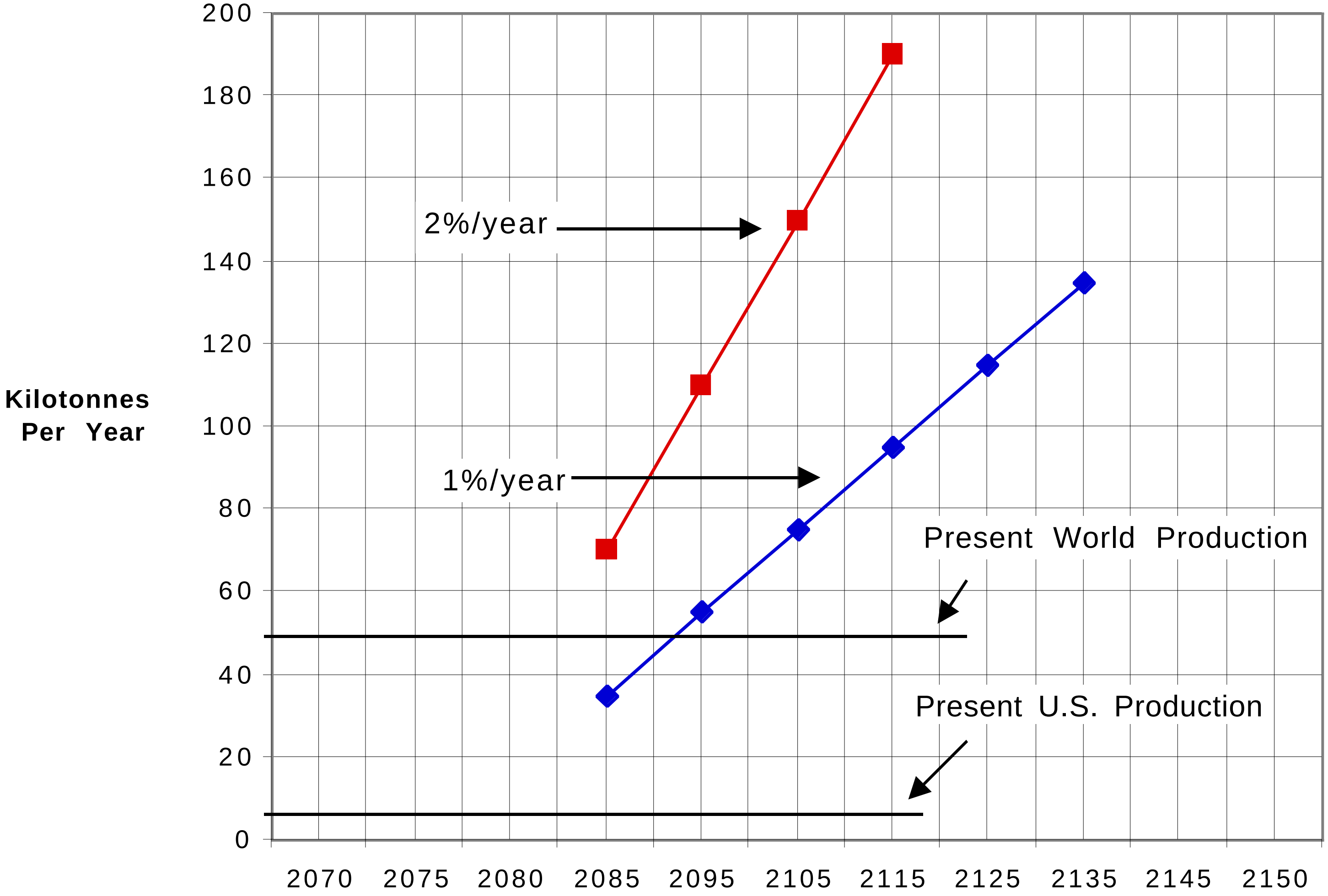
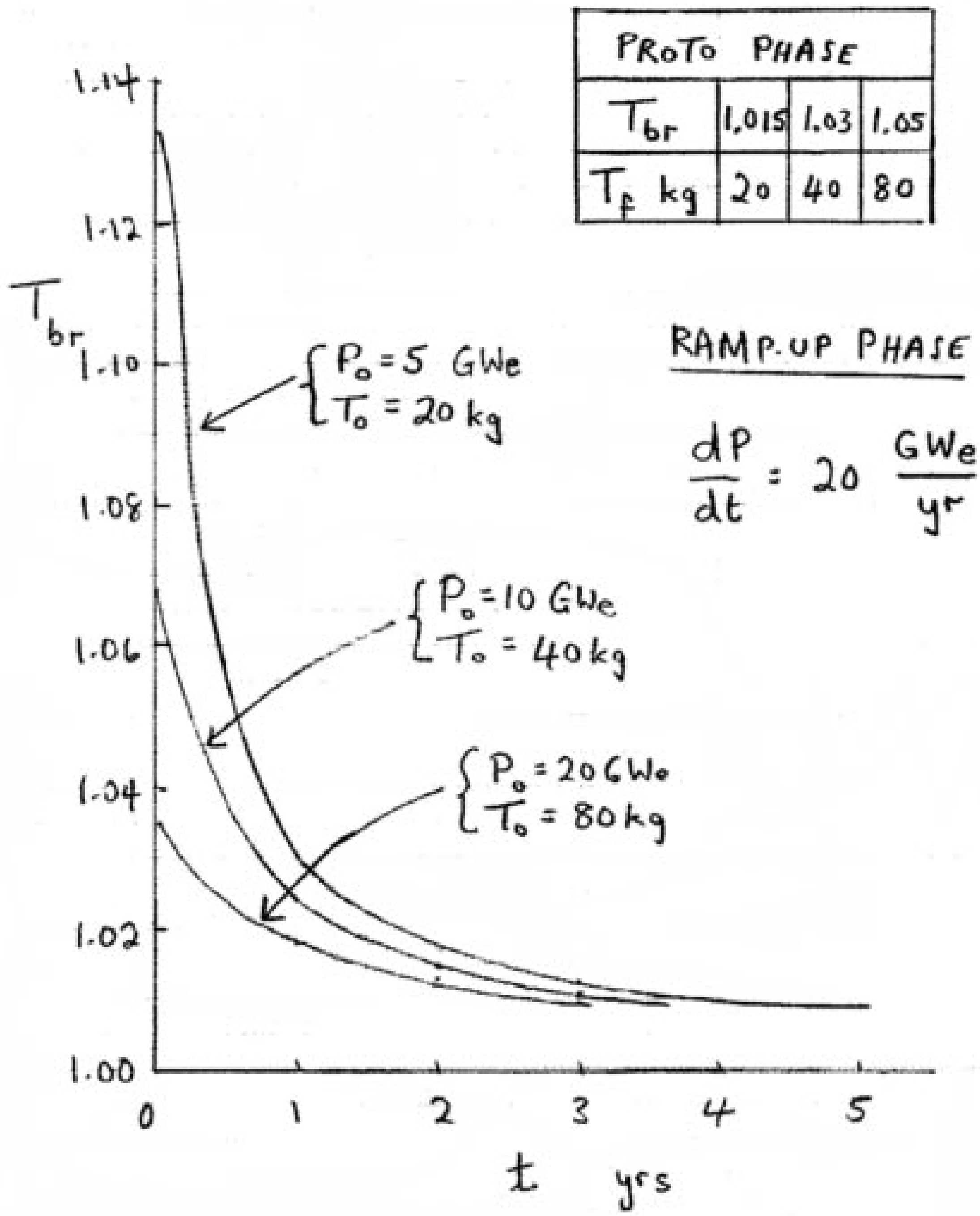
Vanadium Required Per year

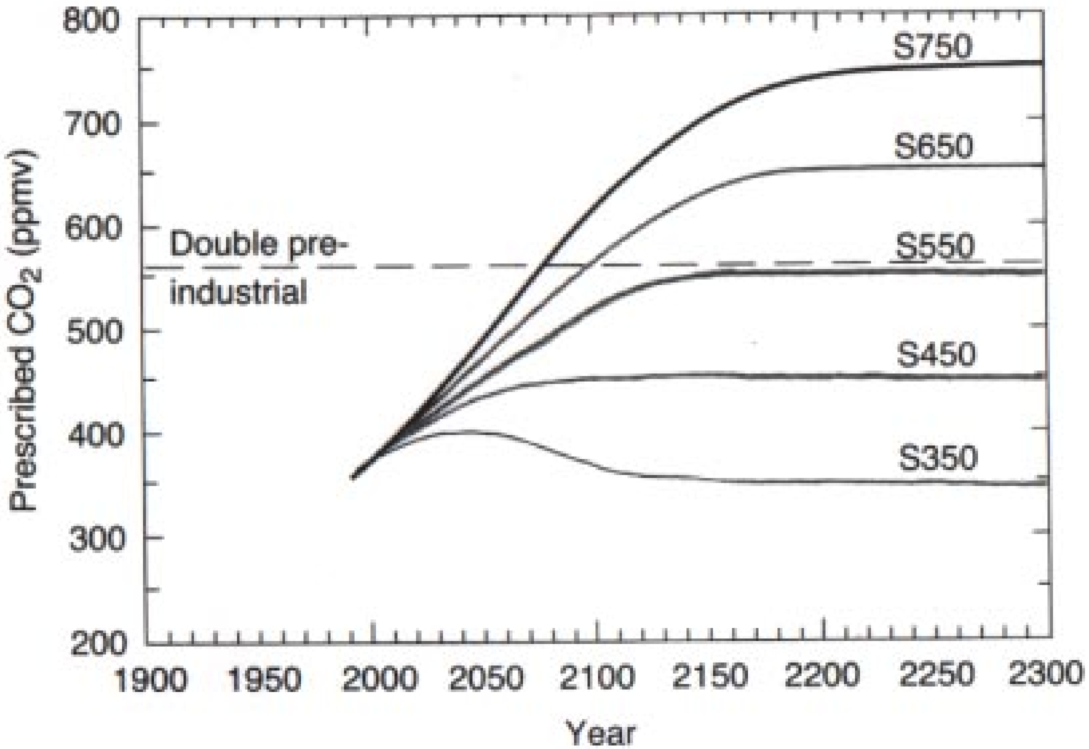
(for U.S.)



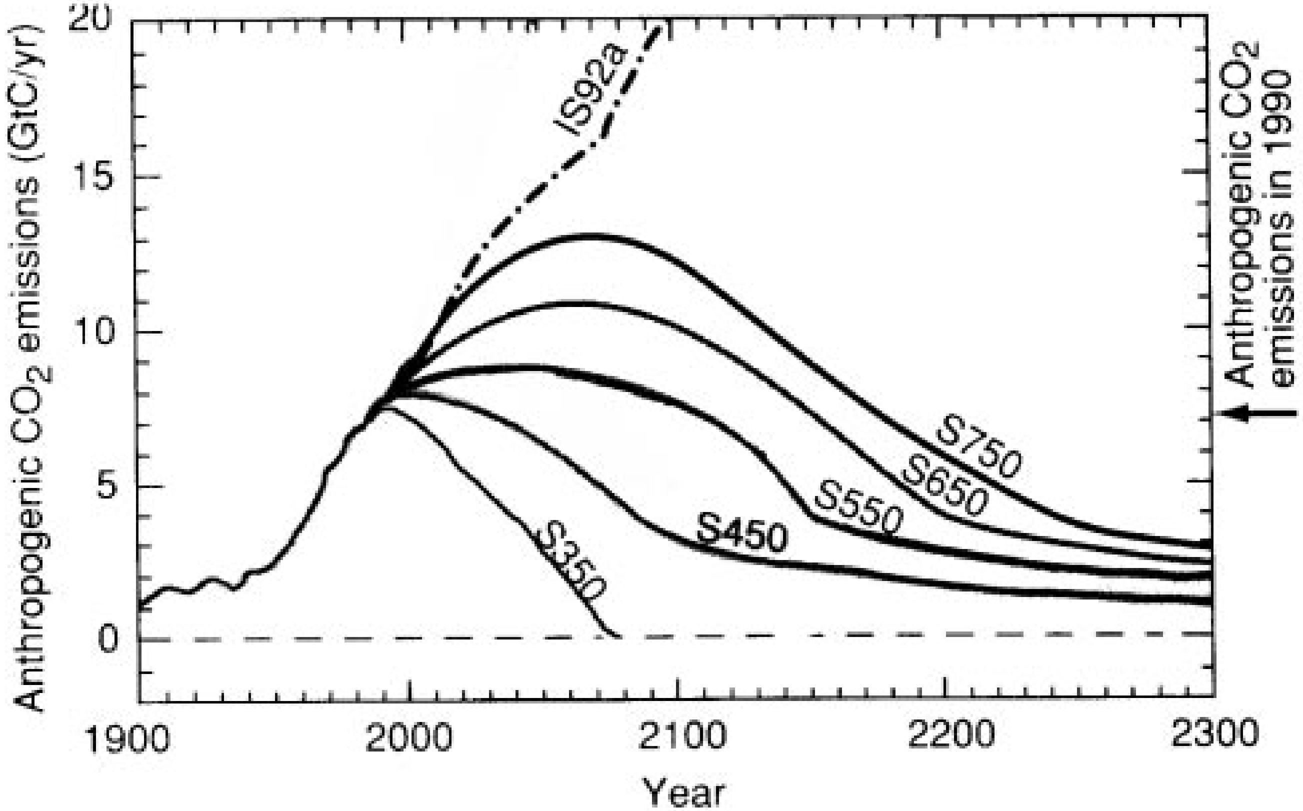


PROTO PHASE			
T_{br}	1.015	1.03	1.05
T_f kg	20	40	80

Projected CO_2 Concentrations



The emission profiles shown in the last figure are projected to result in the following atmospheric concentrations (with corresponding labels) of carbon dioxide.



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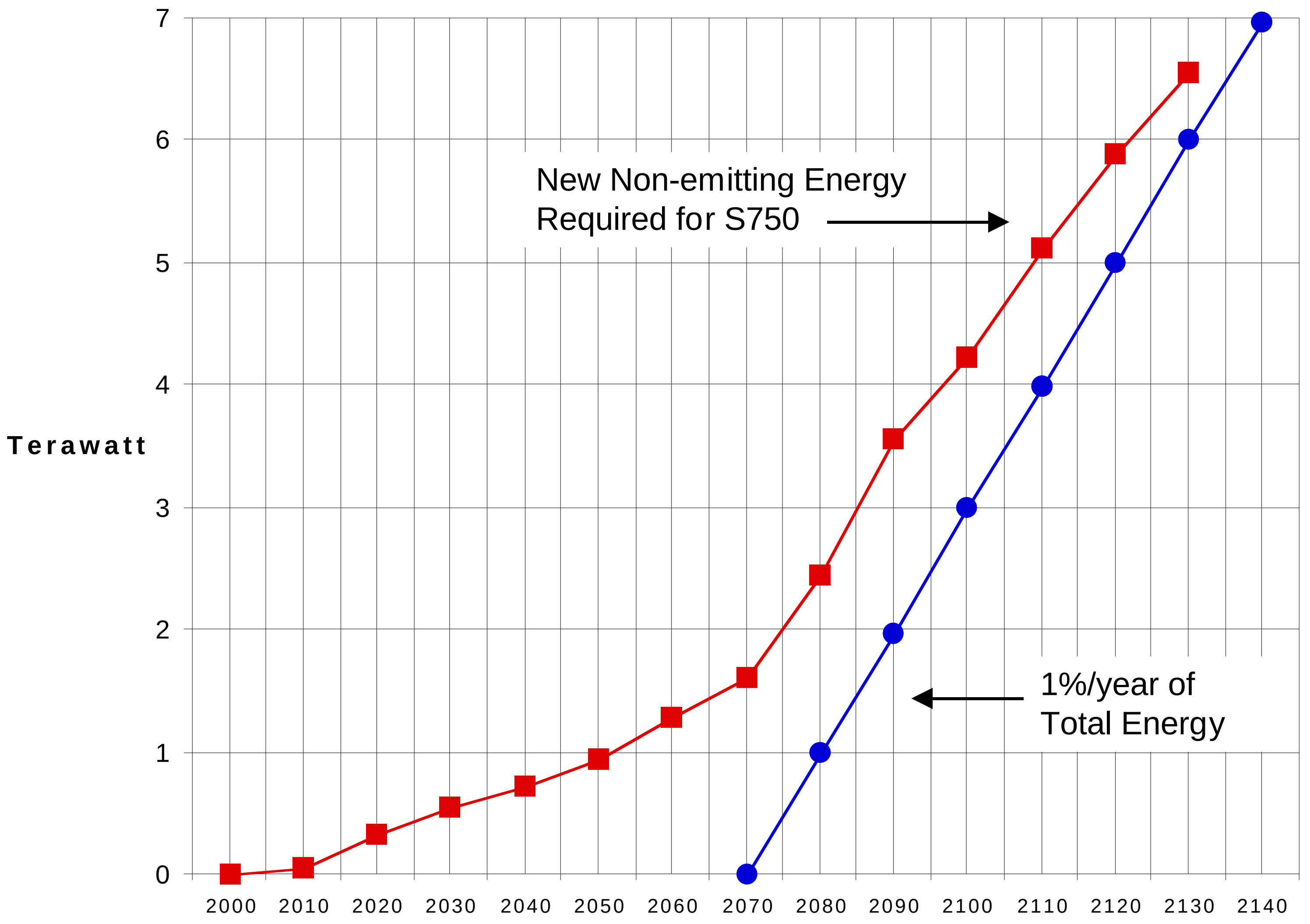
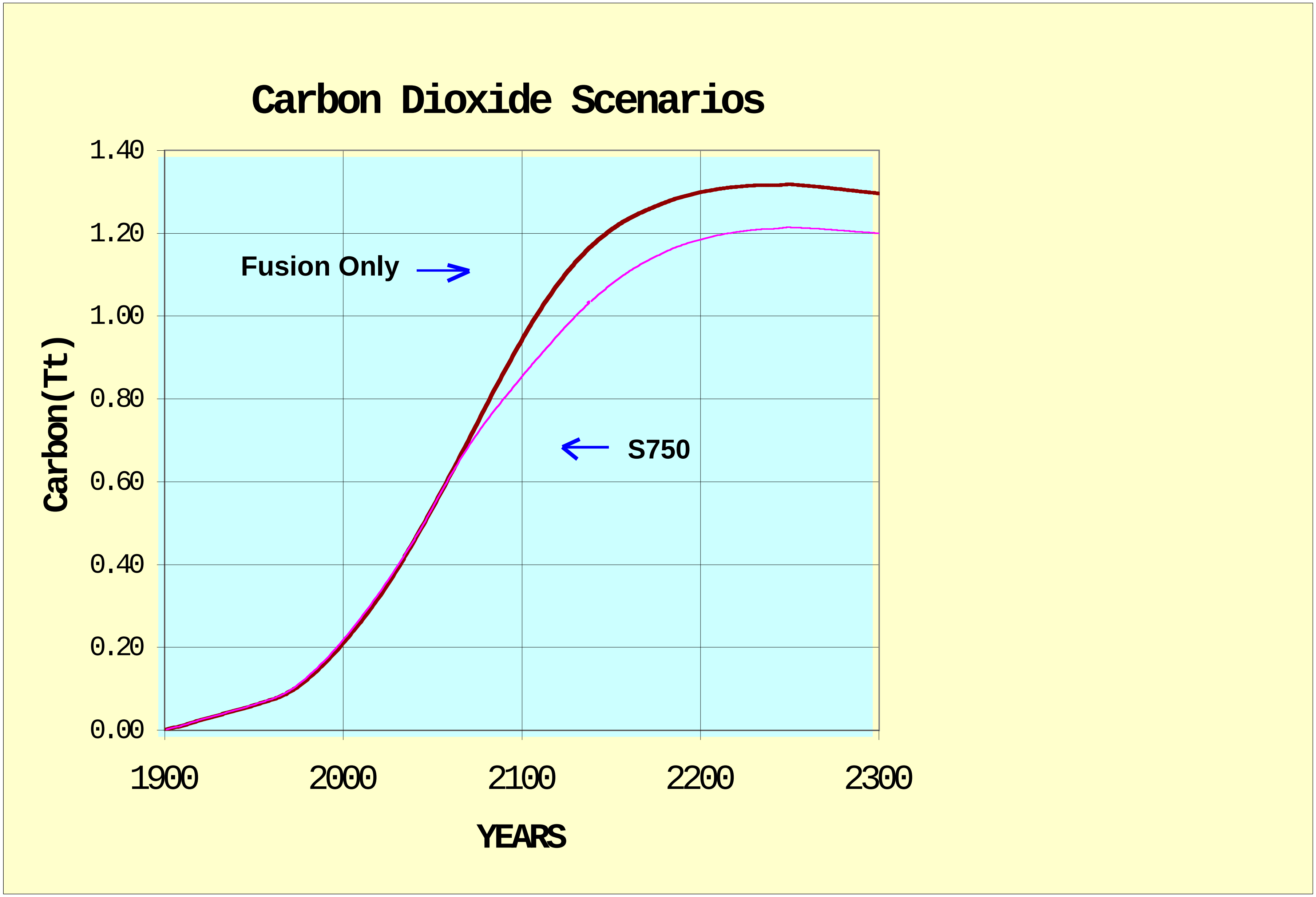
Projected Need for Non-carbon Producing Energy





Carbon Dioxide Scenarios
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Carbon(Tt)
Fusion Only
S750
1900
2000
2100
2200
2300
YEARS

Conclusion

- The number of major fusion cycles (experimental facilities) required and the time to commit to these facilities will determine the development time.
- A go ahead on ITER and a VNS will be required soon to support the assumed development schedule.
- It will be difficult to have a significant impact on the electrical power production during this century with a doubling model for implementation unless the doubling time is less than 7.5 years.
- If we can implement fusion commercialization as aggressively as the French and Canadians fission commercialization we can have a significant impact this century (requires bullet 2).
- The projected waste production from aggressive fusion commercialization in the U.S. will rapidly exceed the present level of licensed low-level waste storage.
- Aggressive fusion commercialization will require increases in production of resources such as vanadium.

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