SUMMARY OF ANALYTICAL FINDINGS

Total national (public and private sector) Dutch R&D investments stood at $6.4 billion in 1995. R&D as percentage of GDP peaked in 1988 and declined until 1993. Since 1993, national R&D investments have recovered slightly. Changes in the private sector's support for R&D are largely responsible for these fluctuations in the overall national pattern of R&D spending. In particular, reductions in the level of support for R&D provided by five large Dutch-based multinational firms was principally responsible for the downturn in the late 1980s and early 1990s. Since 1993, the recovery in private sector investment in R&D is largely attributable to a growing number of technology-intensive medium-sized firms.

Although government support for R&D has gradually increased over the last decade, there have been some significant changes in the composition of government-funded research. For example, the government's strong support for industrial productivity and industrial technology R&D programs in the 1980s has largely disappeared in the later half of the 1990s. Support for agricultural R&D and energy R&D has also decreased over this time period. The largest increases over this period were for general science programs.

A significant fraction (47.9% in 1995) of Dutch national R&D is performed in "semi-public research institutes" and universities. The public R&D performers – universities and semi-public research institutes – are increasingly being urged to lessen their dependence on direct government subsidies for performing R&D and to finance their R&D efforts through avenues such as contracts with the private sector and merit-based grants from the public sector. In doing this, the government is attempting to create a more "market-oriented" research infrastructure (i.e., a situation that is better able to match supply and demand for research). Another goal is to promote higher quality research.

These attempts are in line with a change in policy vision. A better exploitation of R&D results should be achieved by cooperation and fine-tuning between actors involved. Budget pressures and a desire to fund the highest leverage R&D have also led to a growing interest in and use of "foresight studies" by the Dutch government. Through these activities the government is seeking to learn what areas of research are strategically important for the future of the Netherlands and how to get the most out of the research infrastructure by seeking to identify and fund the best university research schools and scientists. Energy R&D has been identified as one of the priority areas for future government support by the foresight studies.

The current major themes of Dutch energy policy are liberalizing the energy market and stimulating development and adoption of energy efficient technologies and renewable energy systems as a way to address climate change.

Energy efficiency policy in the Netherlands is increasingly becoming more active. The government announced that – in addition to further Voluntary Agreements – it might rely more heavily on promulgating and adopting performance standards and regulations, where necessary. These more active, forcing measures are supporting the government's policy focus, which is based on reliance on self-regulation and voluntary agreements.

The Dutch government believes that it is still too early to say precisely what the effect of energy market liberalization (e.g., utility deregulation) will be on the many voluntary agreements in place with the energy sector to promote energy efficiency and private investments in energy R&D. The energy sector's willingness to invest in long term R&D is expected to decrease because of mounting pressures for energy R&D to produce short-term results. In an effort to address this

possible shortfall in private sector energy R&D, the government has included incentives for the further promotion of energy efficiency and the deployment of renewable energy technologies in the new Electricity and Gas Acts. There appears to be a consensus in the Netherlands that the government has a role to play (in consultation with the private energy sector) in guaranteeing an adequate long-term energy R&D effort needed to shift towards a "sustainable energy system." Focus is on solar energy, wind energy, energy from biomass, energy efficiency improvement and an optimized application of natural gas.

Historically, reducing the Netherlands' dependency on oil imports and environmental considerations arising from energy use were the principal drivers of the government's investments in energy conservation R&D and energy R&D designed to further develop domestic energy sources (mainly wind energy, solar energy, and waste/biomass energy). More recently, environmental drivers, especially climate change, lie behind the government's support for energy efficiency R&D and renewable energy R&D.

In the public sector, the overall energy R&D budget declined from 1990 to 1995. However, recent concern over climate change and energy policy has resulted in increased budgets for energy R&D (especially renewable energy R&D) and other ways to reduce CO_2 emissions. The government intends to increasingly involve private parties such as the private sector natural gas and electric utilities in its efforts to prioritize publicly funded energy R&D. The purpose of this is to strive for better coordination across the public and private "energy knowledge infrastructures." Also by better matching "supply and demand" for energy R&D, the government hopes to affect a more efficient allocation of public resources for energy R&D.

The budget for coal R&D has experienced the largest decreases of energy technology area over the past decade. Support for nuclear energy R&D has decreased dramatically, although the Dutch government has decided to continue supporting some nuclear energy research so that it can be assured of having the capacity to carry out nuclear energy R&D if the need should arise in the future. In keeping with the energy policy trends discussed above, government support for renewable energy R&D and energy efficiency R&D has been on the rise for most of the past decade. Recently, the government has begun to provide support for new fuels such as hydrogen, bio-gasses and bio-fuels, electricity technology (grid optimization and storage), and carbon management technologies.

The largest share of government energy R&D (and public energy R&D) is devoted to industrial energy efficiency programs. These programs (along with building energy efficiency programs) appear to be more project-oriented and applied, given that they tend to focus on deploying innovative technologies. Only rather modest sums are allocated to support the long-term development of these technologies (e.g., heat pumps and membranes). The continuing focus on improving industrial energy efficiency will likely necessitate a shift in the types of technologies being developed from R&D centered on optimizing current production facilities towards R&D focused on the improvement of core process technologies.

The private sector concentrates its energy R&D in the areas of oil and gas, energy conservation, and power and storage. There appears to be significant cooperation between (and amongst) private companies and the semi-public research infrastructure in the field of energy R&D.